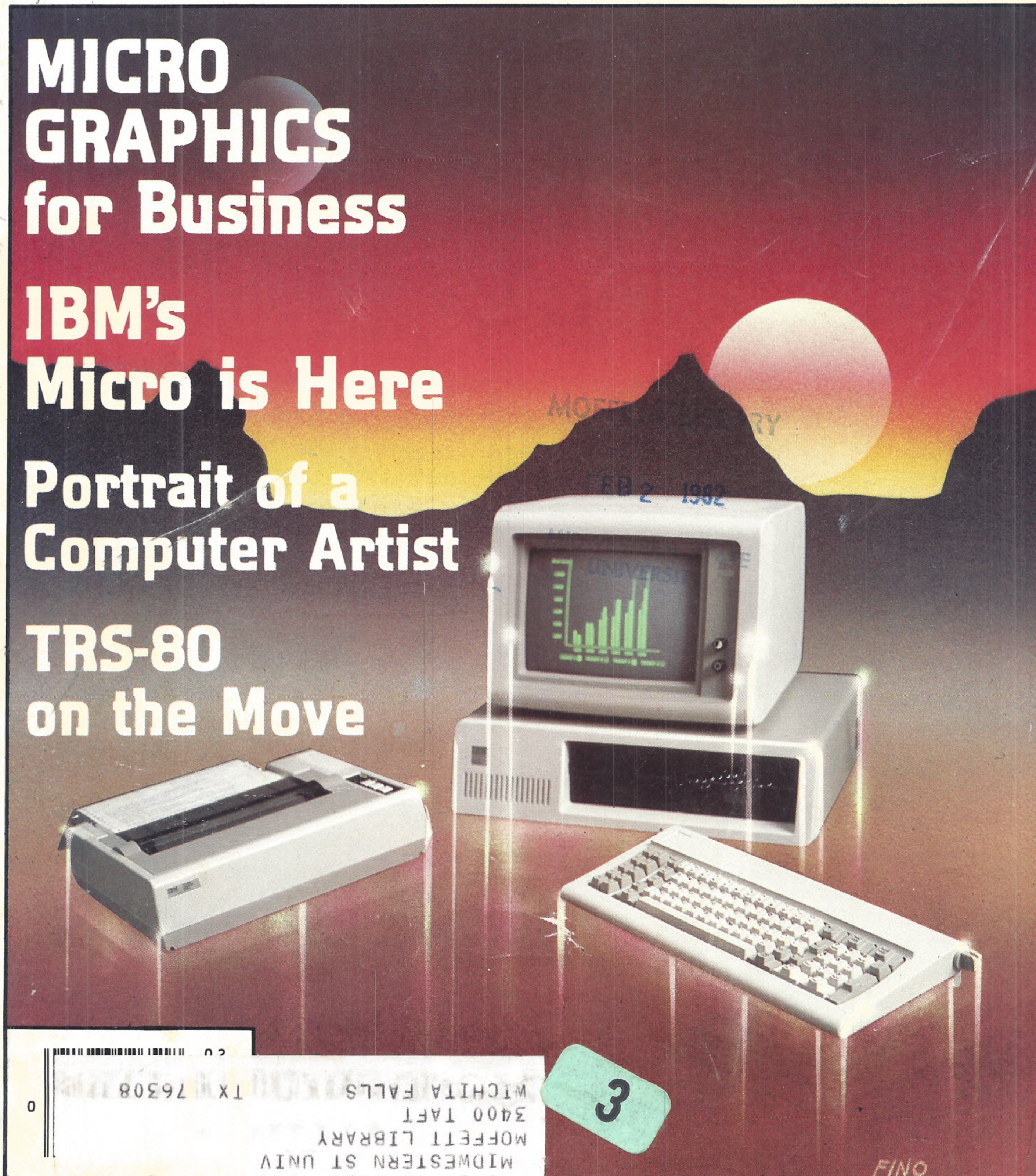
COMPUTING FOR BUSINESS AND HOME

# INTERFACE AGE™

FEBRUARY 1982 $2.50/CANADA/MEXICO $3.00



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CIRCLE INQUIRY NO. 34

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CIRCLE INQUIRY NO. 20

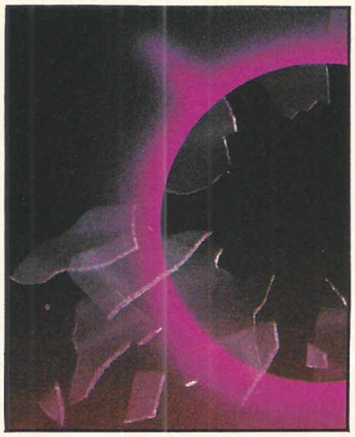
VOL. 7, ISSUE 2
SINCE DECEMBER 1975

FEBRUARY 1982

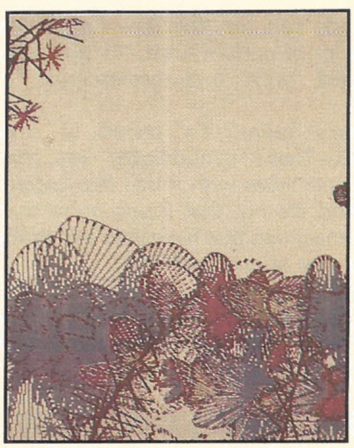
# INTERFACE AGE™

COMPUTING FOR BUSINESS AND HOME APPLICATIONS

**Graphics in Small Business .......66**



**IBM Personal Computer 70**



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***Cover: Computer photo courtesy of IBM, Boca Raton, FL***

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Contact authors of monthly columns by writing to them at INTERFACE AGE, P.O. Box 1234, Cerritos, CA 90701, in care of their respective columns.



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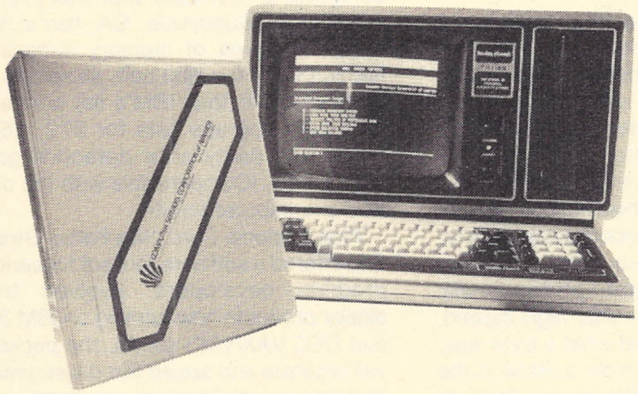

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†Microcomputers for Business, Applications, 1979.

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# EDITOR'S NOTEBOOK

### Where computer merchandisers meet

Comdex '81: like the industry it served, it was almost too big, too complex for a single mind to understand. Dealers who didn't attend this annual gathering of computer manufacturers, wholesalers and retailers missed an exciting preview of new products.

It was a show chock-full of microcomputers and microcomputer people. Since all attendees—buyers and sellers alike—were computer professionals, the level of repartee was high indeed. Nobody had to be told what a byte was; all could tell a ROM from a RAM in the briefest glance. In a time leaning towards economic uncertainty, it was heartening to see thousands of people who have staked their careers on the success of the "little computer." By all appearances, they were convinced they had made the right choice.

Shows like this are a good window into the immediate future. In our eyes, two things stood out: the first commercial influences of IBM's new Personal Computer and the emergence of a super 16-bit microprocessor.

The first tricklings of the monsoon predicted by this issue's *System of the Month* (page 70) were spotting the carpets of the exhibit hall. A number of manufacturers have taken an early lead with products intended for use with the IBM Personal Computer.

TecMar, Cleveland, OH, an established manufacturer of plug-in accessory boards for a variety of microcomputers, introduced a full bag of IBM-bound cards—more than 20 different designs in all. The list includes RAM, ROM and EPROM memory additions up to 256K bytes, multiple I/O ports (both serial and parallel at speeds up to 256K bits per second), and special interfaces to analog laboratory equipment—either directly or via the IEEE 488 bus. Also included is a board allowing up to four IBM units to share a single printer, as well as a video digitizer, motor controller, clock/calendar module and interface for its 5M-byte Winchester disk. On the exotic side, we find a speech generator and something called a Protozoa. All of this won't fit in IBM's standard box, so TecMar also builds an expansion chassis complete with its own IBM-compatible bus and power supply.

We weren't surprised to see a Winchester hard disk drive by Corvus, San Jose, CA, that is attachable to the Personal Computer. Available in megabyte sizes like its cousin Apple expander product, the Corvus disk comes complete with a plug-in controller card. Multi-computer networking for the IBM computer is promised later this year.

Datamac, Sunnyvale, CA, has a half-dozen varieties of memory expansion hardware for the IBM unit, all said to be 20% cheaper than IBM's list prices. A 16K byte upgrade lists for $72; 256K bytes with parity error detection goes for $1,549. (Compare this with the cost of the computer itself!)

First Systems Corp., Manhattan Beach, CA, offered a software tool set for serious program developers. Evolved from similar products now running on IBM 370 and DEC VAX/VMS giants, the package will organize and speed the development of complex applications programs.

Arbitus Totalsoft, Bellingham, WA, offers a package of "old-fashioned accounting programs" adapted from similar products currently running under Oasis. The programs include general ledger, inventory control, accounts receivable, accounts payable and mailing list. Several others are listed, including a Canadian payroll system.

Context Management Systems, Torrance, CA, has designed a set of programs called MBA—Masters of Business Administration. The package includes a VisiClone spreadsheet generator, simple word processor and a primitive data base manager. They're all tied together and enhanced with communications and graphics modules. This integrated system costs around $700, and requires two floppy diskette drives and 192K bytes of memory.

Those with 8086- or 8088-based microcomputers who would like to try IBM's DOS, the Personal Computer's preferred operating system, are now able to buy it directly from Microsoft, Bellevue, WA, DOS's developer. It's called MS-DOS, and currently is the host for a Basic interpreter and Pascal compiler. A Basic compiler is in the works, too.

Not just hardware and software, but other elements of a supporting industry are forming around the IBM computer as well. Strategic Inc., San Jose, CA, offers to help out with its Personal Computer Information Service for those who wish to join the explosion as manufacturers. Newsletters, workshops and marketing research projects are all aimed at maximizing an individual's share of this infant market.

Finally, a yet-to-be-seen magazine is promised for users of the system. Simply called *PC*, San Francisco, CA, this monthly is aimed at the personal or business user of IBM's tiniest brainchild.

Also on the IBM front, we were astounded to see, at this early stage, a

  

whole computer that looks to be an improved-upon copy of the new system. To be marketed by Victor Business Products, Chicago, IL, the Victor 9000 sports an 8088 microprocessor, twin minifloppy diskettes, advanced keyboard and impressive graphics capabilities—just like IBM's unit. It even runs MS-DOS and CP/M-86, the potent pair picked by the three-letter giant. The 9000 lacks IBM's color capability, but compensates by including a voice digitizer and 1.2M bytes of online disk memory in its $4,995 price. Keeping in mind the extraordinary wall of security surrounding the IBM project, and knowing the lead times involved in developing a computer system, we are sure that the 9000 is *not* a copy of the Personal Computer—but the resemblance is uncanny.

Among other interesting observations, the displacement of 8-bit microprocessors by their more powerful 16-bit brothers is accelerating. Computers centered around the 8086 were all over the place, and we saw for the first time a showing in force of 68000-based microcomputers. The Motorola-developed 68000 can run at a clock rate up to 12.5 MHz, and has certain internal features—such as 17 internal registers—that are actually 32 bits wide. The chip is housed in a mammoth 64-pin package. Several new computers are based on the 68000:

Alpha Micro's (Irvine, CA) AM-100/L ("lightning-quick") board. S-100 compatible, it's more than three times faster than Alpha's current computer (also a 16-bit unit).

Forward Technology's (Santa Clara, CA) FT-68M Multibus-compatible processor board, which includes up to 256K bytes of random-access memory on the same card.

CompuThink's (Sunnyvale, CA) Hawk-32 is a computer system complete with Winchester disk and support for up to 16 users.

A new company called Fortune Systems, San Carlos, CA, had the hit of the show: a 68000-based computer with UNIX operating system for $4,995. Not expected until the second quarter of this year, the Fortune 32:16 raised some eyebrows from observers who simply can't believe the low price.

Instrumentation Laboratory, Andover, MA, showed the Pixel 100/AP, a slick-looking computer system that is currently available only with the UCSD Pascal operating system/language.

Microdasys' (Santa Monica, CA) 68K MiniFrame improves upon the 68000's already-generous memory addressing range of 16M bytes with a virtual memory scheme that can access up to four billion bytes. It's available with Microsoft's XENIX, a derivative of UNIX.

***—TF***

**Victor's IBM look alike**





**CIRCLE INQUIRY NO. 39**

Systems Group System 2800 computers. They're making people stand up and take notice.

But then Systems Group products have always appealed to those who appreciate sensible value, high performance, unmatched reliability and prompt, courteous service.

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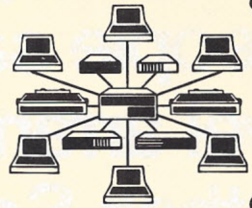

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CIRCLE INQUIRY NO. 69

# LETTERS

### CAI update

Thank you very much for printing the article by Susan Luttner regarding the Computer Assisted Instruction Project in the San Juan Unified School District ("Apple-ications" IA Sep 81). Following is information that should have been included in the article. Over 1,100 school districts have contracted with the San Juan Unified School District to use the Blocks Author System during the 1981-82 school year. In the state of Illinois, a special project has contracted to disseminate the Author System and provide service within the state. Contact me for further information.

Ted Perry
Computer Assisted Instruction
6141 Sutter Ave.
Carmichael, CA 95608

### Still more about sorts

I would like to commend Gene Cotton for his clear and informative articles "About Sorts" (IA Aug and Sep 81) as well as to provide corrections to several programs that he used.

First, the HEAP sort routine did not contain the counters for the number of compares and swaps (C & S). To include these counters, the following changes are needed.

```
275 S = S + 1
555 C = C + 1
580 C = C + 1
582 IF A(R0) ≥ A(R1) THEN 640
585 S = S + 1
```

The following seem to be typographical errors.

```
INSERT—part 1, p. 69, col. 2
  140 IF A(I − 1)≤T THEN 210
SHELL—part 1, p. 146, col. 2
  290 GOTO 140
HEAP—part 2, p. 86, col. 1
  270 FOR M = N − 1 TO 1 STEP − 1
QUICKSORT2—part 2, p. 90, col. 2
  280 C = C + 1
```

I hope that these corrections will make it easier for others to implement the sort routines.

Dale E. Watts
Littleton, CO

### CBT corrections

Dave Hannum's article "A Guide to Computer-Based Training Systems" (IA Oct 81) is in error on several points. Control Data PLATO does not offer a means to project pictures from slides or video tape/disk, although this could be done via the RS-232 port on the terminal On the positive side, the 512 by 512 resolution Control Data 110 terminal that can be dialed up to a PLATO computer can also be used in a stand-alone mode called Micro PLATO, which employs dual density, double-sided 8 in. disk drives.

The leading edge of CBT technology lies in the direction of combining the off-line independence and dedicated processing power of a sophisticated stand-alone terminal with the advantages of a network capable of providing centralized data collection and software distribution facilities. The article should have touched on these trends.

Gary R. Michael
Savoy, IL

I'd like to call your attention to an authoring system that was overlooked in the CBT article. Z.E.S. for the Apple was created in Australia by a group called Zenith Coaching. It is a completely menu-driven system that allows the teacher to create any type of lesson desired. It includes full-color hi-res graphics, animation, cartesian graphs, hints, messages from and to the student, branching to up to nine revision questions for each normal question, and very elaborate student record-keeping (including general lesson status, performance summary, detailed report of each question, actual answers given, and a full class report).

Mary Carol Smith
Avant-Garde Creations
Eugene, OR

### Catching up with busses

Tom Fox's editorial on busses (IA Nov 81) contains a few technical errors that ought to be corrected. A minor error is the statement that Altair was the grandfather of microcomputer manufacturers. Altair was not a manufacturer, but the name of a computer made by MITS (Micro Instrumentation and Telemetry Systems).

A major flaw is the statement that "The S-100 bus is somewhat married to the 8080 (and similar 8085 and Z80) microprocessor integrated circuit chips. With the notable exception of Alpha Microsystems' 16-bit unit, the S-100 bus is quite incompatible with other designs of microprocessor chips."

This statement is very misleading. In the January/February issue of *Microsystems*, Mokurai Cherlin wrote an article titled "The Other Processors for S-100 Systems." The article lists the following processor boards available for the S-100 bus: 6502 (two boards available), 6800 (two boards available), 6802 (one board available), 6809 (two boards available), 2650 (five boards available),

F8 (one board available), 9900 (one board available), 8086/8088 (six boards available), Z8000 (two boards available), 68000 (three boards available), Bit Slice (one board available), Pascal Micro-engine (one board available). The list is not exhaustive.

Though these boards may not be in wide use, this situation does not represent what I would term "quite incompatible." I do not quarrel with the intent of the editorial but I feel that you are obliged to get your facts straight before engaging your typewriter or word processor.

Steven H. Leibson
Boulder, CO

**Color him skeptical**

I trust that Ryan Gale (Letters, IA Oct 81) is being metaphorical when he says that using home computers for word processing is "analogous to discovering how much you can increase your productivity by changing from...crayon to manual typewriter...those of use using Selectric IIs can only wonder what the fuss is all about." If the Selectric he's talking about is a word processor like the Wang, he may be right. But having switched from a Selectric II to a Radio Shack model III with Scripsit, I can tell you that even this low-cost system can run rings around the Selectric—even the correcting model.

And while Mr. Gale seems to feel that microcomputer word-processing is mainly just an extra hobby for those who have computers anyway, I know of at least four other professional writers who have purchased micros just for word processing. (In case you're curious, that tally includes two Radio Shack model IIs, a North Star and a Heathkit H-89.)

Ivan Berger
New York, NY

**Taking umbrage**

Every so often I find discrepancies and inaccuracies in articles printed in your magazine but the November issue had several. I am forced to take umbrage.

In the article on word processing, Dennis Christopher compares daisy wheel printers. He reports the Radio Shack model has a rated speed of 25cps. Not so. And even a cursory check of the catalog would show it is rated at 43cps, comparable to the Xerox it was compared to.

In the printer hardware article, the chart shows the Texas Instruments 810 as serial only. Not so. It offers dual outputs at the stated price.

I sensed a bias against the TRS-80, at least from some of your authors. For instance, Christopher said service on the $4,500 Radio Shack system is "slower" than the $10,000 Xerox. Service contracts are available in most of the same areas where Xerox offers its costly agreements. And it didn't occur to him that an owner could easily afford two TRS-80 systems and still have a trip to Hawaii left over.

Finally (and this is a very personal bias) Carl Heintz has again addressed CP/M as "the industry standard." Other journals have called it the "de facto standard." Good Lord! In an industry that is now honoring those who have participated for five years as "old timers" what is the honor in calling such an "antique" a "standard"? In a field where the technology changes each week, where nothing from 1976 is still "state-of-the-art," where the very chip it was designed for is of historical interest, what does CP/M have to offer? Where is the power of the system? The sophistication? The efficiency (especially in disk storage)? The user-friendliness? Its main virtues seem to be its ubiquity and the proliferation of countless compatible software items. And boy, there sure are a lot of them—like locusts or Pintos. Logic that encourages the continuation of such a system just by virtue of its weight, ought to give a "syntax error." If you like the numbers argument, I've got a great deal on abacuses...

John Revelle
Rohnert Park, CA

**Drive problem solution**

Re: Peter Chan's letter (IA Oct 81) regarding difficulties with power conversions to the Shugart drives in his TRS-80 model IIs, Shugart manufactures four different versions of the SA800 drive for the four permutations of 110 or 220 volts and 50 or 60 Hertz. Conversions from one frequency to the other are accomplished by changing the drive pulley and belt. Conversions between 110 and 220 volts require a replacement of the drive motor. Conversion from 110/60 to 220/50 need both changes. The drive will apparently work if only the belt and pulley are changed, but operating the 110 volt motor at 220 volts will cause overheating and speed variations,



  

which will create an out-of-spec diskette. Mr. Chan should see his local Shugart distributor, which is Caduceus Industries, Ltd. in Quarry Bay, Hong Kong to determine whether his drives have been properly converted.

Donald B. Lowe, Jr.
Shugart Associates
Sunnyvale, CA

### Missing document mystery

Re: "Micro-Mathematician" by Dr. John C. Nash (IA Jun 81), I was particularly interested in your reference to the IEEE Draft Floating-Point Arithmetic Standard. The AmD9512 chip's documentation also makes mention of this standard, but in spite of several attempts over the last few months, I have been unable to find out whether such a document exists, let alone its contents. (The Standard's bodies here have never heard of it.) I am particularly anxious to establish whether the format recommended for a 32-bit floating-point binary number is the same as that adopted for the AmD9512 (*not* the 9511), namely:

1-bit sign
8-bit binary exponent, biassed by 127
23-bit mantissa with an implied "1" as the m.s. bit

This is the format used in the (software) floating-point library routines in Pro Pascal, a Z80 native-code Pascal compiler that we have developed and are about to market.

I should be most grateful for any light you could shed on this matter.

Mike Oakes
Prospero Software
London, England

*Re: the Proposed Standard for Binary Floating-Point Arithmetic (IEEE Task P754), Draft 8.0 was published in IEEE Computer, March 1981, pages 51-62, with additional expository articles following in the same issue.*

*Draft 5.11 was published in a special issue of SIGNUM Newsletter (a publication of the Association for Computing Machinery) of October 1979.*

*Recently, a draft standard in French has been produced by sub-committee 47B of the International Electrotechnical Commission (Binary Floating-Point Arithmetic for Microprocessor Systems, 47B secretariat 6). This appears to be a direct translations of IEEE Draft 8.0, but I can find no statement of parentage and, unfortunately, the document is marked "not for reproduction, July 1981." A proposed standard should have widespread distribution.*

*The AMD 9512 uses a 32-bit floating-*

*point binary format that appears to be compatible with the proposed standard, at least for normalized numbers. The proposed standard has some interesting and useful ways of treating non-normalized numbers, which I hope to explain in a column at some point (when the dust settles from the current political debates in various standards committees). The 9512 also appears to use a double-precision format compatible with the proposed standard. Of course, it will not produce results that necessarily match the rules imposed by some of the clauses in the standard.*

***—JCN***

### Spare parts, anyone?

My business uses a Cromemco Z2 computer and I have had three years of good service with it. However, this summer a piece broke in the PerSci disk drive and I have been unable to get it fixed. I have written PerSci, Cromemco, an advertiser in the Cromemco user's group newsletter, as well as having a local dealer try to get the part for me.

Cromemco did answer my letter after about six weeks, but offered no help. PerSci has yet to be heard from. The advertiser answered promptly, but did not sell parts. The local dealer drew a blank with PerSci, also.

So I limp along with a single drive, not knowing where to turn. Cromemco is doing well (probably best of the S-100 companies), and I see that PerSci has a new prestigious ad out. But can these companies compete with IBM, offering no spares support?

Malcolm Gilli
President
Mega Corp.
Toney, AL

Thank you for the opportunity to respond to Mr. Gilli's letter.

No one here has ever heard of Mr. Gilli or Mega Corp. and we cannot find any letter from him. The thing that puzzles me is why he didn't follow up with another letter or a telephone call when things weren't going right.

It is an unfortunate situation for the end user when his dealer does not support his product. We find this to be particularly frustrating when we have a very large stock of spare parts for all of our products. These parts are all readily available to the end user, the dealer, and Cromemco. All they have to do is order them.

If the end user wants to get the drive repaired, there are several agencies that are anxious to provide the service. We provide those that are interested with technical information, parts and training.

Dennis Ammons
PerSci, Inc.
Los Angeles, CA

### Reader interface

I have acquired an Ithica Audio IA1130 disk controller board. I assembled it and got it working quite well, but I do not have any software to use it as a disk controller. I would appreciate any assistance in this regard. If anyone knows of a source of these boards, I would like to purchase another three bare boards or complete kits to finish the project.

R.C. Elliott
37 Ingamells St.
Garran, A.C.T. 2605
Australia

I am working on a new program entitled "How Not to Pay Income Tax At All," which will include sub routines such as:

How to have more cash in your pocket each month.

How you can benefit from inflation.

How to buy income property with $10 down.

How to double your money each year.

How to invest your money to make more money than you will ever be able to spend.

How to do this without leaving your home.

Because of my limited skills in programming, any help your readers can offer to get this program going would be appreciated.

I have an Apple II, a TRS-80 model I, an Underwood manual typewriter and an Atari pong game, all in good condition.

Paul Raymer
Box 42831
Las Vegas, NV 89116

Please inform your readers of a new publication that we have received entitled "Computer Based National Information Systems, Technology and Public Policy Issues." The price is $6.50 per copy, Stock No. 052-003-00852-1.

Remittance should accompany each order in the form of check or money order payable to the Superintendent of Documents. You may also use your Superintendent of Documents deposit account number, or Visa, or MasterCard account number furnishing the expiration date.

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CIRCLE INQUIRY NO. 17

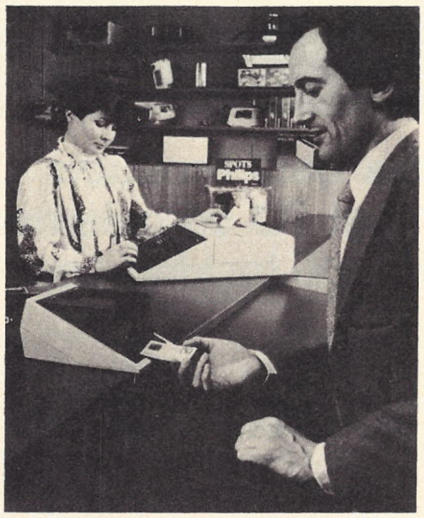
# UPDATE

### Revolutionary electronic payment card developed in France

French scientists have designed a unique electronic payment card for making private purchases. Scientists at the Laboratoires d'Electronique et de Physique appliquee (L.E.P.) at Limeil-Brevannes, France cooperated with RTC La Radiotechnique-Compelec and Philips Data Systems, France, in devising the card.

The card contains two chips: a microprocessor and a memory. It also has magnetic strips for identification and registration, so that it can be used in the ordinary way for drawing cash automatically from a bank. The card can also carry information about the user and a passport photograph if required. The dimensions and mechanical properties of the card conform to the international ISO standard for credit cards.

The card, which serves in some ways as a checkbook, has been designed for an experimental project in which French



banks and postal/telecommunications authorities are cooperating. The user can periodically arrange with his bank to enter a particular amount into the card's electronic memory; this money is then available for making payments. Shops that accept electronic payments have two terminals: one for the customer and one for the shop.

A customer wishing to pay by card inserts the card in the appropriate terminal. By keying in a particular code, the customer can see how much money is left on the card. The shop assistant keys in the amount to be paid on the shop terminal, and this is then passed on to the chips in the payment card in the customer terminal. If the balance stored in the payment-card memory is sufficient, the shop assistant receives a signal indicating that the payment can be accepted. The customer then keys in his personal code and bank code, and the amount of the payment is transferred to the memory in the shop terminal, together with the data that the shop requires for collecting the money through its bank. At the same time, the credit balance in the customer's card memory is reduced by the amount of the purchase.

### Microcomputers to lead growth of graphics market

Microcomputer-based systems will open up new graphics markets in the 80s even more spectacularly than minicomputers did in the late 1960s, according to a report from Strategic, Inc., San Jose, CA.

The market made up of computers (including microcomputers), microcomputer-based terminals and software, will reach $5.9 billion in 1985. At that time, it will be divided nearly in half between large systems and microprocessor-based equipment, according to Strategic.

The report predicts that terminals incorporating 16- and 32-bit processors for CAD and other demanding applications will show the highest rate of growth, projected at more than 150% per year. Business graphics, including Hewlett-Packard systems with VisiCalc Plus and Apple computers with VisiCalc/VisiPlot, are projected to grow at 49% per year, becoming the largest single segment.

Taking large and small systems together, CAD/CAM is the second fastest growing segment at 36% per year. Here the combination of interactive design on microprocessor-based workstations with number-crunching on mainframes and minis for electrical or mechanical analysis and generation of CAM data will lead to greatly improved productivity at lower cost in many industries.

Graphics on home computers, especially for games and in education, will have growth rates of 32% and 28% respectively over the five-year period from 1980 to 1985.

The study also notes the growing size of the captive coin-operated game market, which is not included in the computer-based systems total. There are now 2.7 million such games installed, and 1981 sales will reach $1.1 billion.

### Survey measures satisfaction among hardware and software users

Management Information Corp., Cherry Hill, NJ, recently published the results of its sixth annual survey on small busi-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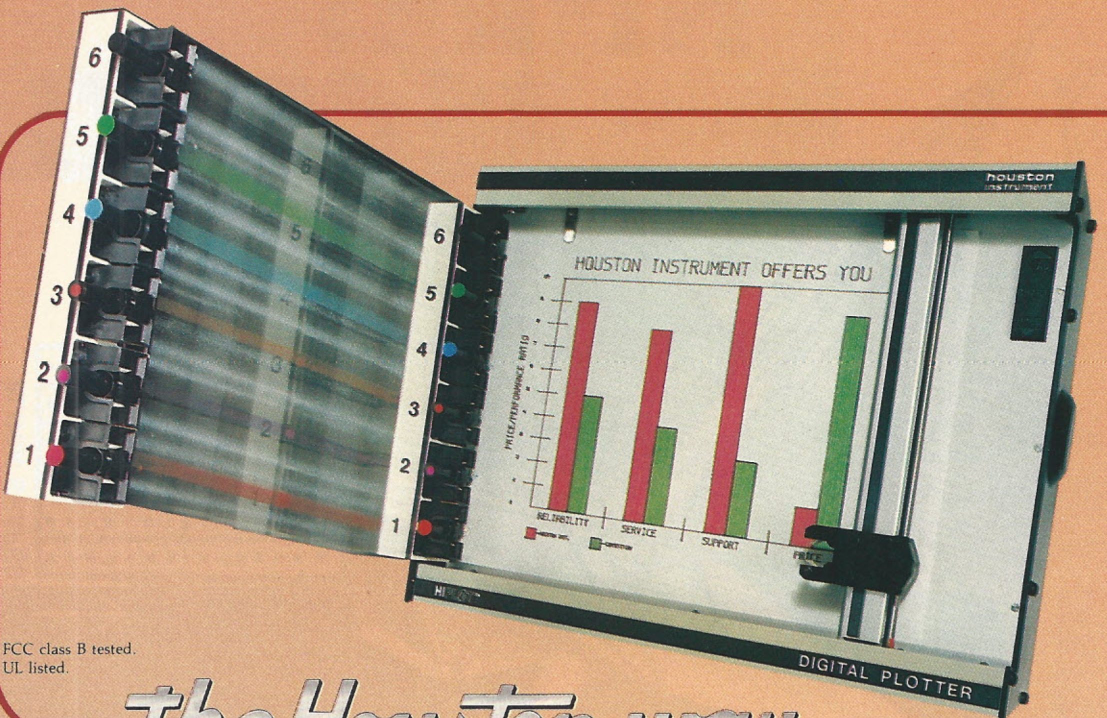


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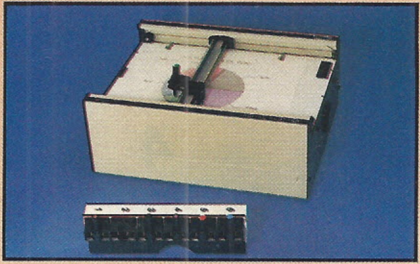

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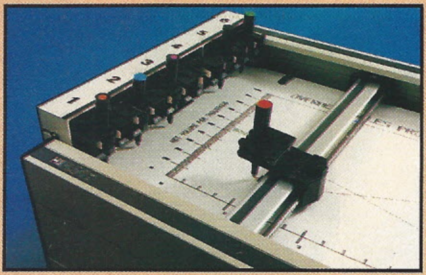

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CIRCLE INQUIRY NO. 35 FOR LITERATURE
CIRCLE INQUIRY NO. 36 TO HAVE A REPRESENTATIVE CALL

ness computers, peripherals and software. The results represent the responses of over 474 companies using almost 600 small business computer systems and 959 peripherals. Also rated are 245 software packages.

Users rated their computer equipment on a scale of 1 (poor) to 4 (excellent) in each of five categories: performance, reliability, ease of use, service and manufacturer support. Products with ratings of greater than 3.0 in each category, and for which at least five responses were received, were awarded the MIC Certificate of User Commendation.

Winners of the certificate in the computer category included: Alpha Micro; Apple II Plus; Data General Nova; Vector Graphic systems VIP and B; and IBM units 32, 24, and 5110/5120.

In the peripherals category, terminals included: ADDs versions 25, 40 and 100 and DEC VT 100. Printers listed were: Apple Silentype; Centronics versions 306, 700 and 701; Epson MXB; IBM 1403; Texas Instruments models 810 and 820; Diablo 1630, and 1640 versions; DEC LA-36 and 34; Printronix LP 300; Radio Shack TRS-80 III and IV models; and Anadex 9500. Disks included: Apple II, CDC Hawk; Heath H-17; Microdata Reflex; and Micropolis.

Software winners included: MicroPro WordStar; Personal Software VisiCalc; SMI MCS; Radio Shack Scripsit; SMI; and SMI BCP.

Other findings of the survey pointed to an increasing number of business micro users; slightly higher ratings of service and support than last year's survey; and dominance of various accounting packages among software used on the systems investigated.

### Papers solicited for California educational conference

A call for papers has been issued for the Sixth Western Educational Computing Conference, to be held in San Diego, CA, on November 18 & 19, 1982, under the sponsorship of the California Educational Computing Consortium.

The papers should deal with computers and computer applications in any area that might be of interest to instructors and administrative personnel dealing with computers at the college or university level.

Original papers with two copies should be sent no later than March 1, 1982 to Professor Francis Grant at Center for Information and Communications Study, California State University, Chico, CA 95929.

### CRT graphics terminal market to exceed $1.4 billion by 1986

The CRT graphics terminal industry is growing by leaps and bounds, according to a recent report by Venture Development Corp., Wellesley, MA.

The fastest growing product segment in the graphics terminal industry is the color raster scan market with unit shipments growing at a compound annual rate of 64.8%. Color raster scan industry leaders include Ramtek and Intelligent Systems. IBM, another contender, is coming up from the rear with its new 3279 color unit. Industry observers report that there are tens of thousands of orders for the 3279, but VDC research found that less than 50% of those in the field are being used for graphics. Most 3279 users plan to upgrade these terminals to handle graphics applications in the future, but currently most are only used for alphanumerics.

Other alphanumeric terminals will compete with graphics terminals in the future, as users install graphics circuit boards such as those being marketed by Digital Engineering. These circuit boards add graphics capability to DEC VT 100s and Lear Siegler ADM-3As. VDC believes that these circuit board terminal enhancements will affect the growth rate of CRT graphics terminals.

According to Wendy Abramowitz, VDC analyst, "Digital Engineering has a good concept, which is already cutting into sales of graphics terminals for business applications. Small companies that previously could not afford a graphics terminal can now put graphics capabilities on a dumb terminal for only $1,000."

One thing that the circuit board terminal enhancements are lacking is color, which is becoming increasingly important, especially for process control and image processing applications. Many CAD/CAM vendors are also switching from direct view storage tube terminals to high resolution color raster scan terminals. In fact, by 1986 color units will account for 84.8% of CRT graphics terminal shipments.

### London taxis to employ computerized dispatch system

Cab service in London will soon be computerized, so that in addition to courtesy, riders will get service more promptly.

London-Wide Radio Taxis recently ordered a Honeywell DPS 6/74 small computer system valued at about $300,000 to automate dispatching and billing operations in the company's West London control center. In a typically British understatement, the company

describes its new Computer Cab system as the world's most advanced.

Incoming telephone calls will be automatically answered by a microcomputer-based system and will be channeled, in sequence, to a team of telephone operators equipped with visual display terminals. Job details will be keyed directly into the computer as they are given over the telephone. All jobs will be immediately "stacked" by the DPS 6 and shown on dispatchers' video display terminals; advanced bookings will be stored by the computer.

The dispatchers will radio signal to drivers, using a network of transmitters around the captial. Cabs will be fitted with sophisticated radio communication systems and, to accept a job, a driver will simply press a button on the control panel. This will immediately register his call sign with the computer. A tone signal will tell the driver if his bid for the job is accepted, and he will then press another switch to obtain job details.

Finally, details of finished jobs will be stored in the computer for automatic accounting. Monthly statements will be prepared for drivers, showing details of their earnings, while invoices will be automatically produced for credit account customers.

Currently the company controls a fleet of 750 taxis in central London and plans to increase it to 2,000. "Faster turn-around in processing calls and information will mean that each cab will be able to do more trips each day—so we will be supplying a lot more rides in London," said Geoff Kaley, managing director. Eventually, the company plans to extend the computerized operation to its separate suburban fleet.



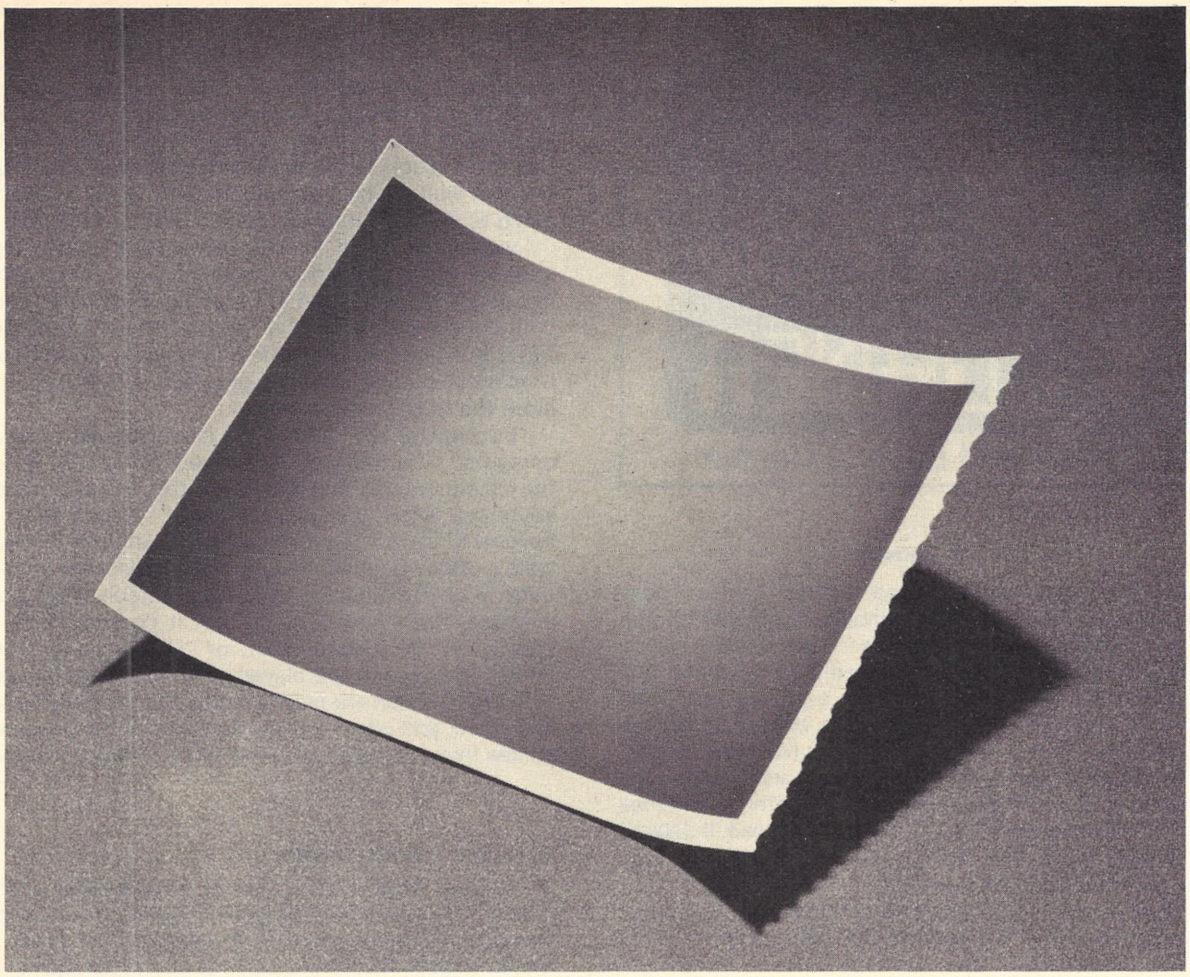
### "Thinking" computers advancing ahead of schedule

Computers that really "think" are here, according to Dun and Bradstreet's *Business Month*. A recent issue of the publication reported that computer systems are on tap that read, write and hold conversations. Researchers at companies such as IBM and Gentech and Schlumberger are experimenting with computer systems that can analyze geological formations, design new biological genes and even read, digest and answer business correspondence.

Until recently, it had been assumed that such ultra-sophisticated software, commonly known as artificial intelligence, would not be commercially practical before the late 1980s because too vast a reservoir of computer memory was required. However, advances in microelectronics have drastically reduced memory costs, and industrial artificial intelligence research has mushroomed.

Artificial intelligence differs from traditional software in two fundamental ways. For one thing, in place of normal computer language such as Fortran, it uses an esoteric tongue called LISP, which can manipulate symbols, words, phrases, complex formulas and numbers. And instead of using mathematical calculations to solve problems, these programs can take logical shortcuts.

Some of the most promising applications for artificial intelligence have been in "expert" systems, according to Dun and Bradstreet. A computer is programmed to duplicate as closely as possible the decision-making process of leading experts with these systems. Besides keying into the computer all known information on a particular subject, programmers interview the expert at length to determine how he processes information to make judgements.



# This is a picture of all the printers in the world that outsell the MX-80.

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That seems like a straightforward enough policy. But when we first introduced the MX-80, the competition laughed. Now they're cutting prices, introducing "new" models, and running splashy color ads, all in an effort to catch up. And they're not laughing.

But you don't have to take our word for it. You've got a choice: you can buy the printer that's been embraced by several hundred thousand computer fanatics all over the world. Or you can buy something else. And take your chances.

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CIRCLE INQUIRY NO. 30

# GAME CORNER

by Patrick and Leah O'Connor

### C.A.I. Games

Children are very good at inventing their own games. Today my daughter and I sat down at the computer to play her favorite game. She calls it "Find my letters," but it really isn't a computer game at all. It could be played on a typewriter just as easily, but it's still a good game for a pre-schooler. The rules are very simple. One player types something on the keyboard while the second player keeps his eyes closed. Then the second player looks at the screen and tries to type the same thing. Sometimes it's just a single letter, sometimes it's a word, and sometimes it's just a lot of nonsense. It doesn't matter what is typed; the object is to look at the video and find the same keys on the keyboard.

The game doesn't even require a program, but it can still keep the interest of a five-year-old for quite some time. It's fun for my daughter, because it's something she can do with Mommie. It is definitely not a babysitter-type game. You cannot turn it on, sit a child down in front of it, then walk away. This is a game you play together. It could even be called an educational game, because it helps the child learn to recognize letters and find them on the keyboard. It also teaches kids that there is nothing scary about a computer, but I'm sure that children with a microcomputer in their home would never be afraid of it unless they weren't allowed to touch it.

I suppose it would be possible to come up with a program to generate random strings, print them on the video, then test to see if the child typed in the same string. You could even print out some kind of visual reward if the child got the letters right, but the original game is preferable. It probably won't hold a child's attention for long, either. After all, it's much more fun to play with Mommie.

"Find my letters" wasn't the first game we played on the computer. The first one was called "Find your letter," and the object was to find the first letter of your name on the keyboard. After the players found "their" letter on the keyboard, the game continued by finding the letters for the child's other favorite people. Sometimes we would try to think of all the different names the person might go by. For example, Pat's letter is "P," but it could also be "D" for Daddy, or "P" for professor, or "U" for uncle. "Find your letter" was a game we played when my daughter was three.

Young children are fascinated by the computer's keyboard and video, and you would be surprised at how many different games they can come up with if one is willing to let them play.

***—L.O.***

### Versions for the adults

I've been thinking about a computer billiard game for a future column, and several philosophical points came to mind as I was developing the program. It would be possible to program a billiard game that would play the computer against a human player, but, unlike computer chess, computer pool is a game where the computer can play a "perfect" game against any human opponent. Instead, I was thinking of a quasi-game that would hone the human's table-skills for the real human-vs.-human—more a billiard tutor program than a billiard game. Playing a game against a perfect opponent is no fun; in the case of straight pool, the human player would never get a shot again once the computer got a turn. Random "muffed" shots could be programmed into the game, but the human player would know that the computer was being made to play down to human level, and that would ruin it for most players I know.

In line with what was previously mentioned about games being "more fun to play with another person," it's interesting to see how arcade games using digital computers have developed. The current generation of arcarde games (Space Invaders, Pac-Man, etc.) don't merely pit the human player against the computer; they give the human a comparative ranking against other human players who've challenged the same game. It's really humans playing against humans, even though only one human at a time is playing with the machine. The human-vs.-computer contest, especially in games of the Space Invaders/Pac-Man category, includes games of skill, in which the expertise of the computer can be made impossibly better than any human player. The human players know this. They know that the rules or the speed of the program can be changed until absolutely *nobody* can score a point on the machine. That's not the objective. The objective is to put the challenge of machine competition just within reach of a good human player, then allow the high scorer of the day to rack up points for comparison with other human players.

A number of my students are home-computer hackers. They may have a diskette with a Pac-Man clone of some type for their home machine, and never play the game at home, yet still go out to arcades and play Pac-Man in the company of friends. Partly, I think, the arcade-game thing is a social event. If there were a crowd of others (at a party, for instance) the

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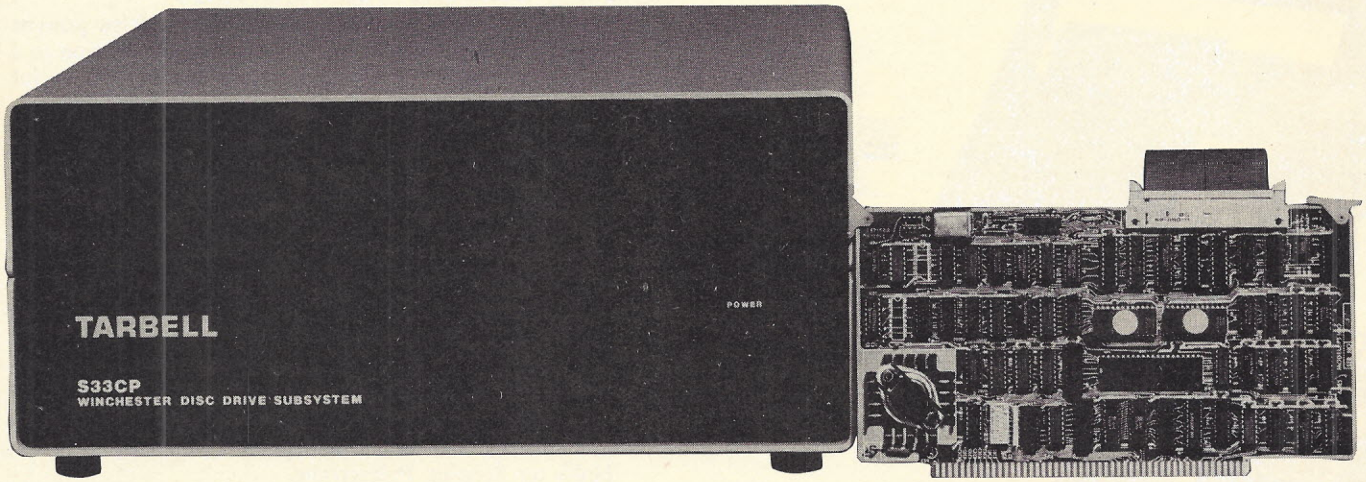


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home computer programmed with Scarfman or Puckman would be just as popular as the arcade machine. But the same people wouldn't sit alone at the machine for hours, playing the game just for the sake of playing against it.

One reason is the ego-trip factor: there's nobody to impress if you *do* run up a really high score. The computer won't be impressed, and, if it is, who cares? Nobody values a computer's opinion very highly. On the other hand, home-computer hackers might sit at home playing Puckman in secret with the home-computer, provided it's enough like the real thing at the arcade, to sharpen their skills. The ultimate objective, of course, is to then go to the arcade, start a game of Pac-Man, and impress the other humans by racking up a score that really blows everybody else out of the water.

In the end, it's only the human-vs.-human comparison that counts. Programmers of games ought to think of writing game programs that are really computer-aided-education for games that are played between human players. A good program to sharpen up skills at baseball or tennis might be even more popular than a program that plays the game itself. It would, however, have to sharpen up those human skills used in the real, physical game. This isn't as easy as specializing the game down to micro proportions by simplifying the rules. It could engage quite a bit of programming talent, as well as a wide interdisciplinary knowledge of fields from physiology to kinematics. Is there anybody who would like to take this ball and run with it? In the words of Howard Cosell, "It remains to be seen."

**Fog index revisited**

In a previous column (IA May 81), Al Baker discussed the Fog Index. We recently received a letter from Leo Jankowski, a reader in New Zealand, with an improved version of the program. The Fog Index is a measure of readability. What it actually measures is not the clarity of individual words—rather the complexity of their structure. It was developed by Robert Gunning, who was called in by The Wall Street Journal to find out why subscriptions were dropping. Readers could read the same material more quickly in news magazines, they told Gunning. To find out if this was true, Gunning compared the WSJ with other business news magazines using the Fog Index. It turned out that the WSJ had a Fog Index of about 10, and the average business reading level at that time was about 8.

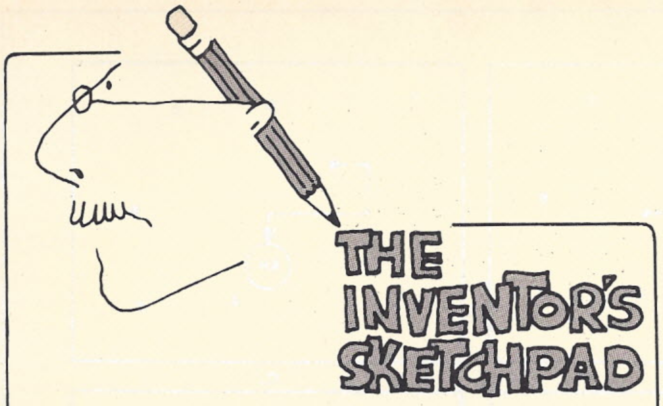
After looking over the Fog Index program and Mr. Jankowski's improvements, I noticed something unusual. You compute a Fog Index by analyzing a sample of written material, in terms of the number of words, sentences and big words in the sample. (Big words were defined by Gunning as having three or more syllables.) Sure enough, both Al's and Leo's listings included a REM statement that stated "big words (three syllables or more)." The line of code REM's by that statement, however, did not count syllables. It counted if the word had eight or more letters. This doesn't bother me—it probably makes as good a definition of *big* as anything—but it bothered me that the REM statement implied syllables were being counted.

I began to wonder, though, if a syllable-counting routine couldn't be devised. I thought up an algorithm for doing syllable-counting, then asked an acquaintance who's a grammarian about it. My algorithm counted vowel/consonant transitions. I counted each crossing from a vowel to a consonant as another syllable. My grammarian agreed this was a pretty good way to go about it; 'as good as anything else' since syllables in English are pretty subjective. Vowel/consonant transitions work in German, too. (I find German syllables are also subjective, but maybe that's just because I'm not very good at German.)

I came up with the accompanying program listing for a syllable-counting Fog Index analyzer, which runs considerably slower than the 8-count program, but *does work*. It works more like Gunning's original definition, but I don't know if it makes much difference in the long run. ☐ ***—P.O.***

***Program on page 148***

CIRCLE INQUIRY NO. 13




by Roger C. Garrett

## Robot Civilization on the Moon

In a paper titled Self-Replicating Systems—A Systems Engineering Approach—*NASA Technical Memorandum* 78304, Georg von Tiesenhausen and Wesley Darboro of the Marshall Space Flight Center, present a fascinating plan for exploiting the resources of the Moon. They propose to place on the Moon a single self-sufficient factory composed of four main components, each equipped with sophisticated robots (figure 1). No humans would be required for the operation, except possibly for the initial setup.

The components would be (a) a processing unit to mine lunar minerals and process them into material for (b) the production unit, which would manufacture basic components to be suppliėd to (c) the assembly unit, which would assemble them into major pieces of hardware. These would then be combined by (d) the universal constructor into complete new factories, each of which would be comprised of parts a, b, c and d.

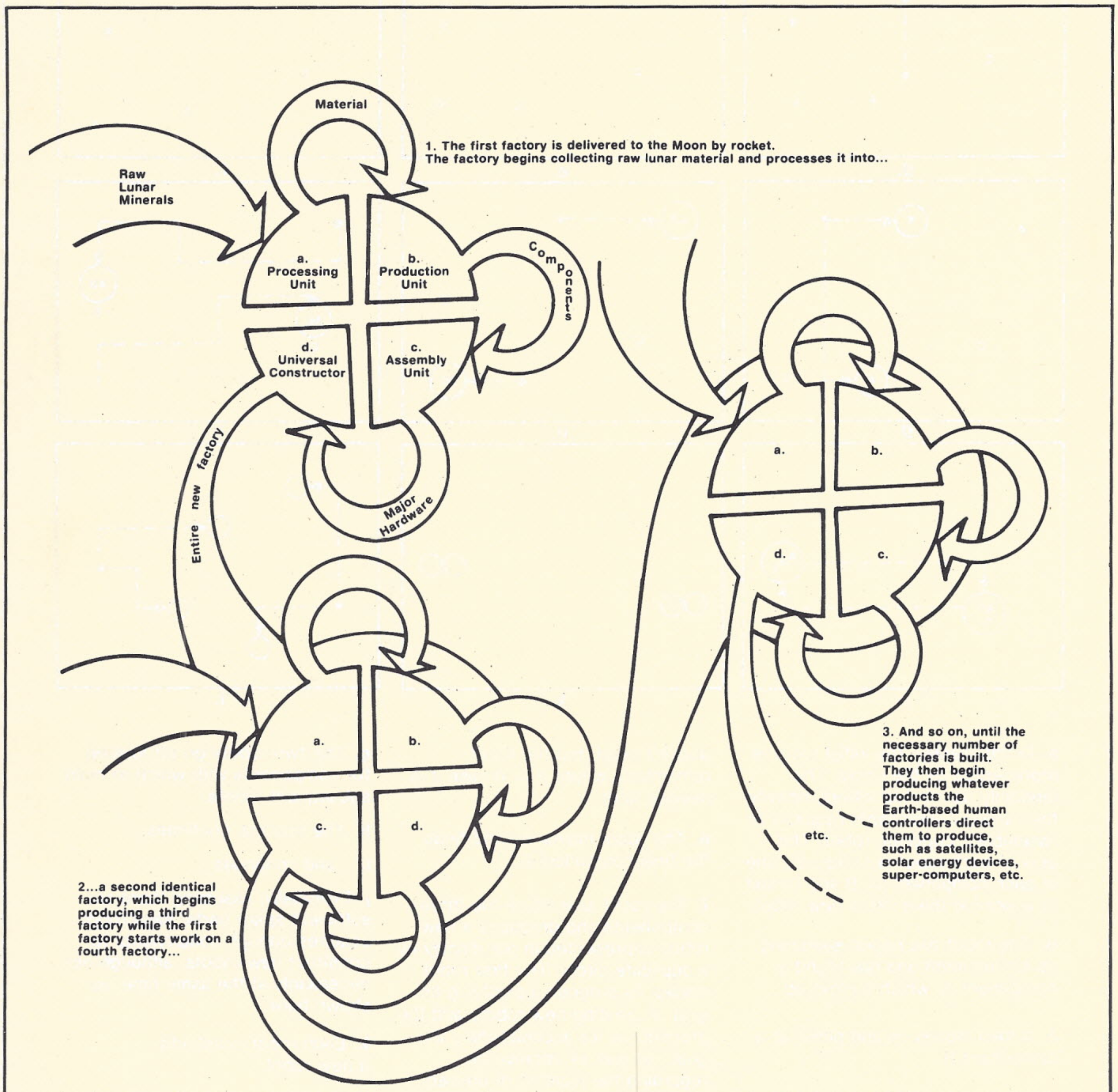
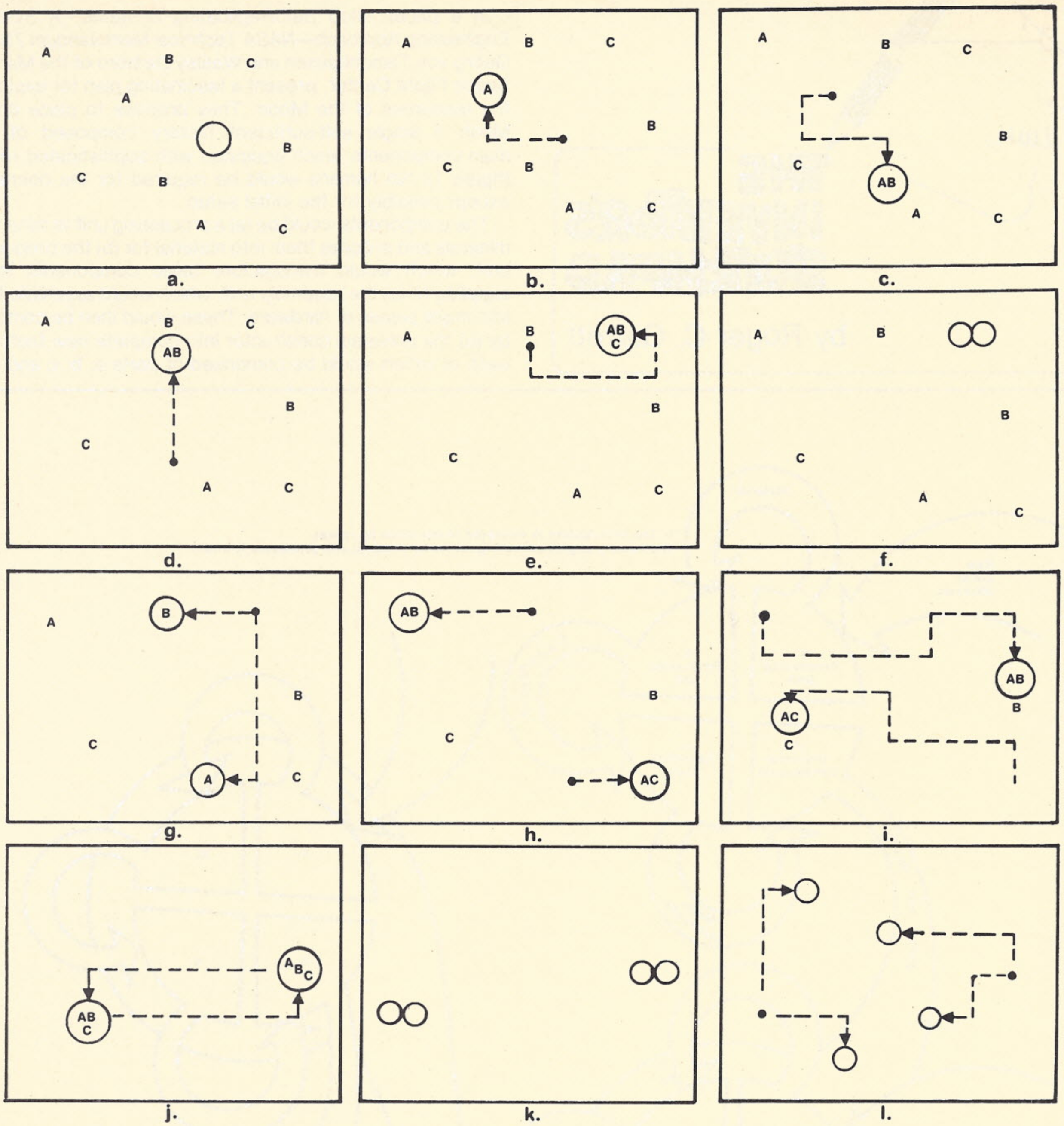



**Figure 1. A self-replicating factor** could be built on the Moon, according to the authors of the NASA report, which would multiply itself at an exponential rate using the free mineral and solar energy resources available there. At some point in the replication process, it would stop and change its goal to producing, for example, satellites or human habitation compounds.




**a.** In this display, the initial robot is represented by the circle. The randomly distributed letters indicate the various components required to assemble a duplicate robot. The goal of each robot is to acquire one of each component (A, B and C) and to assemble them into a new robot.

**b.** The robot has begun searching its environment and has found a component A, which it picks up.

**c.** It then moves on and picks up a component B.

**d.** Further searching brings it to another component B, which it doesn't need, but the robot remembers where it is in case it is needed later.

**e.** The robot moves on and finds the final component C.

**f.** The robot assembles the three components and produces a new robot, represented in our display by a duplicate circle. The first robot copies its program (specifying its goal of creating new robots and the procedures for accomplishing the goal), as well as information regarding the location of unused components. The robot copies into the new robot and turns it on.

**g.** The two robots go off looking for components with which to build subsequent robots.

**h.** The process continues...

**i.** ...and continues...

**j.** Eventually, assuming there are sufficient spare parts, each robot acquires enough components to construct new robots, although not necessarily at the same time, as shown here.

**k.** Each robot constucts a new robot.

**l.** And now four robots go off seeking their endless replication.

**Figure 2. The concepts of self-replication can be investigated using computer simulation.**

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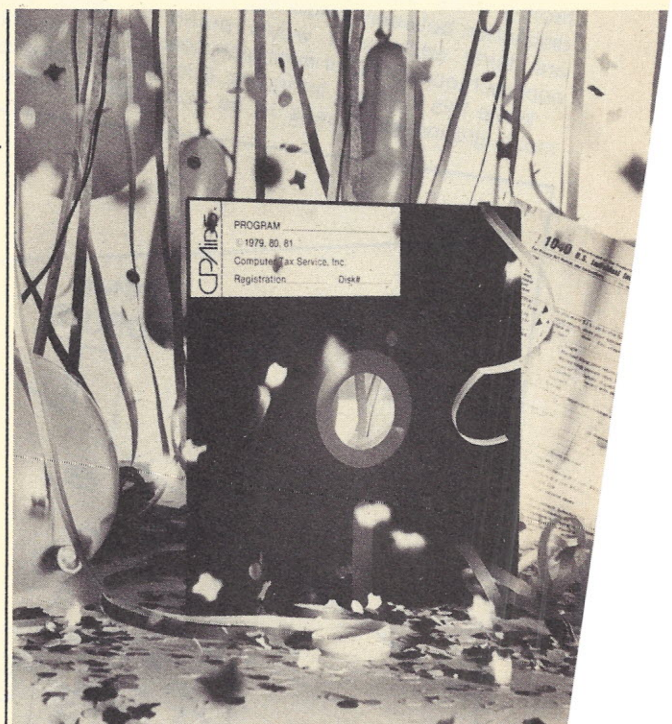

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This new factory would then begin mining, manufacturing, assembling and constructing, to produce its own new factory. At the same time the factory produced another offspring, the proliferation of new factories would proceed at an exponential rate. The authors of the memo estimate that it would take about one year for the first factory to produce its clone, within ten years there would be 1,000, and after a mere 30 years, the Moon would be overrun with one billion factories. Obviously, they would have to be instructed to stop multiplying at some point or they would turn the entire Moon into a mass of scurrying robots.

The authors present this scenario as a means of utilizing the Moon's resources with the least amount of effort and capital investment (human effort, that is: those robots would get exhausted). Only the initial factory need be lifted by rocket from Earth to the Moon. After that, it is a self-replicating system. Of course, to be of any practical value, the factories would have to be capable of more than mere replication. At some stage in their "life," they would stop duplicating and begin building lunar bases for human habitation, Moon-to-Earth transportation systems, medical processing systems, satellites and so forth.

As the authors describe it, the functions of the several factory units would overlap quite a bit. It seems that the distinction between producing, assembling, and contructing are fairly arbitrary. I would prefer a simple two-stage approach consisting of mining/processing and assembling.

While this is pretty intriguing, it is merely a proposal, and much groundwork needs to be done before the U.S. can seriously consider such an undertaking. In fact, groundwork is just the right term. We should first try building a self-replicating factory here on the Earth before attempting anything as grandiose as a lunar mission. And we personal computer enthusiasts can play an instrumental part in the research by doing experiments on our own.

I suggest two possible approaches: first, we can write computer simulations of self-replicating systems to test out our theories (figure 2). Second, we can simplify the processes and use available hardware. It is not really necessary to incorporate the entire process of converting raw minerals into finished products. Let's start at a higher level and work our way down. Suppose, for example, that we have a room filled with high-level components (figure 3), such as mobility units, power units, intelligence units (computers), sensor units (vision, hearing, etc.), effector units (arm/hand devices) and communication units. In the room, we place one complete robot with instructions to build a second robot from the available components, and to transfer its own programming to that new robot when it is done, so that the new robot can begin constructing its own duplicate.

#### Intelligence must be developed

The hardware is mostly available today. The challenge (and it is an exciting one) is to develop the intelligence necessary for the robot to complete its tasks of searching for the various components and assembling them, of communicating with the newly-created robot, of providing them with a "blueprint" of themselves so that they can build and repair themselves.

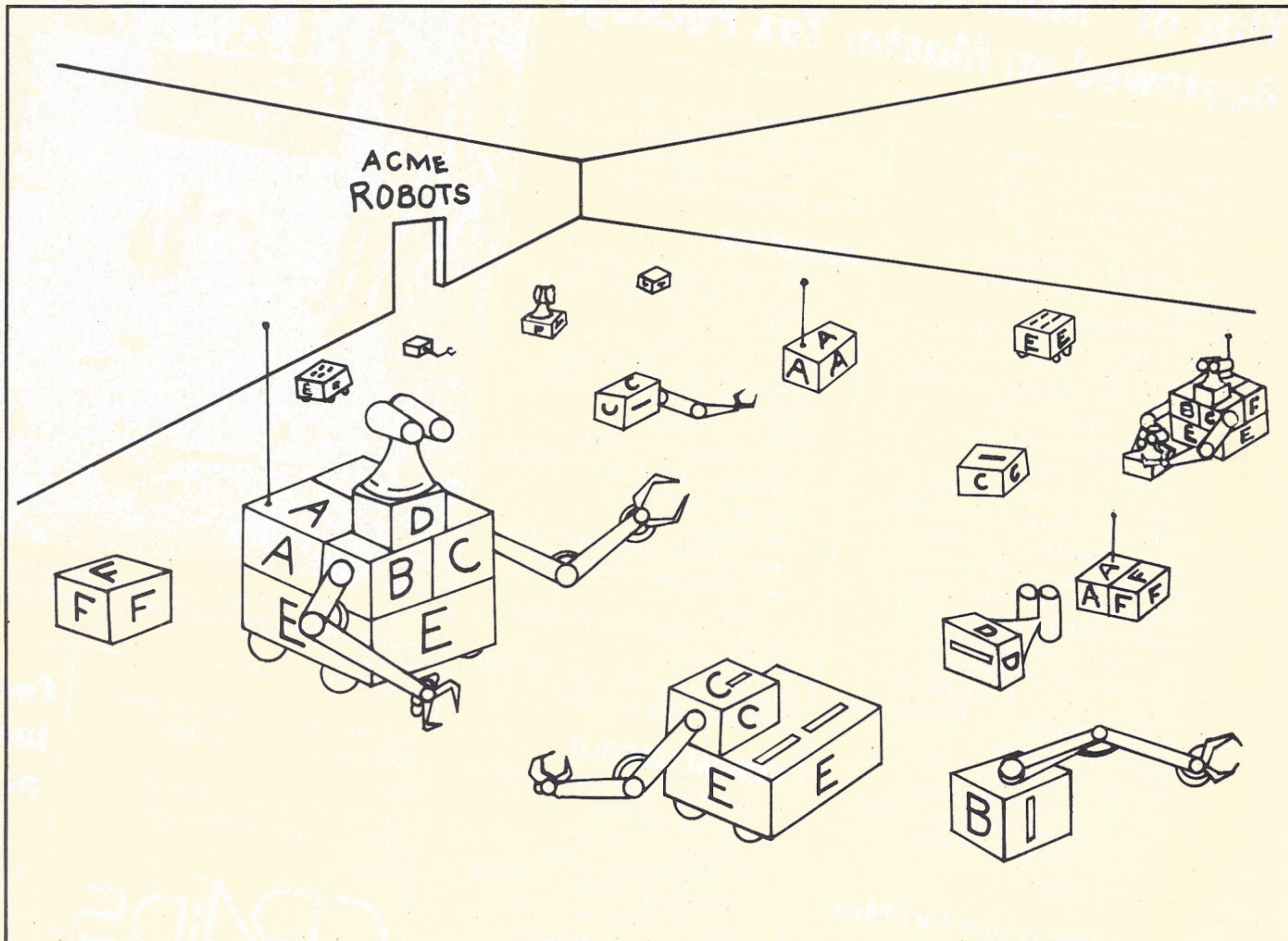


**Figure 3. An initial attempt at self-replication could be performed by using relatively high level components.** A completed robot would be placed in an environment containing a variety of components and instructed to reproduce itself. Knowledge gained from such experiments would then be applied to the more complex tasks of assembling components from lower-level devices, and eventually from simple raw materials. At that level, of course, some type of furnace and processing tools would also be required, all built by the robots.

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Once there is more than one robot in the environment, they can assist each other in locating parts and performing the more difficult assembly tasks.

And as we master these programming techniques, we can move on to the more challenging problems of assembling the higher-level modules from the lower-level components like chips, wires and circuit boards, wheels and axles, gears and motors. Going further, we then develop processing techniques so that the robots can construct the chips, boards and sheet metal themselves from available minerals. The key is to start with available technology at a high level of component sophistication. As we gain an understanding of the necessary robot intelligence, we can move back down the ladder to the more elementary components. Then we will be able to send our factory to the Moon, sit back and watch as a new "life" begins growing there, reproducing itself, and providing us with free energy and minerals, and a virtually limitless supply of robot workers.

As an aside to this look into the future, let's offer a possible solution to the problem of getting minerals from the Moon to the Earth. It uses the "mass driver" concept, in which a linear induction motor is placed on the moon, which propels objects to escape velocity. Figure 4 shows the details. □

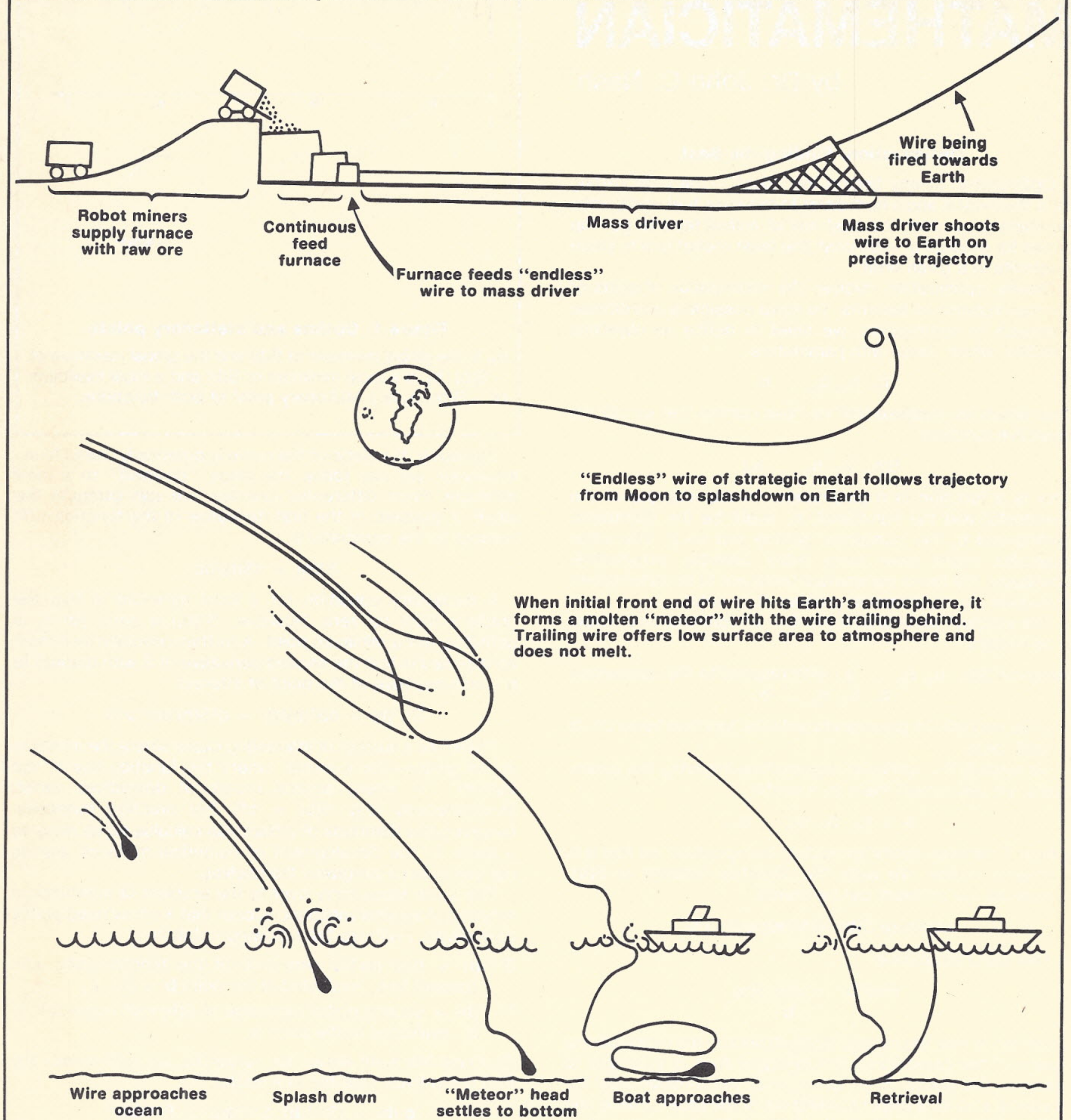


**Figure 4. Mining and transporting strategic minerals from the Moon to the Earth** could be one possible task for all those robots running around the surface of the Moon. One possible method of transportation might be to form an "infinite length" wire propelled by a mass driver towards Earth. When it encounters the Earth's atmosphere, the forward end would partially melt, but the trailing end, presenting very little surface area to the air, would simply glide through and splash down in the ocean to be reeled in by a retrieval craft.

# THE MICRO-MATHEMATICIAN

by Dr. John C. Nash

### Optimization: Finding the Best

Optimization means finding the "best"—the best setting for a thermostat and a humidistat to minimize fuel costs while maintaining comfort; the best mix of animal feed to get top prices for product at least cost; the least rocket fuel to place a satellite in a given orbit.

Clearly, optimization involves the minimization of costs or the maximization of benefits. To make possible a quantitative approach to optimization, we need to define an objective function, which varies with parameters

$$b_1, b_2, b_3, \ldots, b_n$$

over which we suppose that we have control. Let us call the objective function

$$S(b_1, b_2, b_3, \ldots, b_n)$$

This is a function in n parameters. In the example of the thermostat and the humidistat, $b_1$ might be the thermostat setting and $b_2$ the humidistat setting and $n = 2$. The other examples might have many more possible parameters. Obviously, the fewer parameters there are to be determined, the easier the optimization problem is to solve.

The simplest general statement of an optimization problem is as follows:

Minimize $S(b_1, b_2, b_3, \ldots, b_n)$ with respect to the parameters $b_1, b_2, b_3, \ldots, b_n$.

That is, vary all the parameters until the function takes on its lowest value.

To simplify the writing of expressions involving the parameters, we will collect them as a vector

$$\mathbf{b} = (b_1, b_2, b_3, \ldots, b_n)^T$$

where T denotes matrix (or vector) transposition, so that **b** is a column vector. We write the objective function as S(**b**). Therefore our problem can be stated:

Minimize S(**b**) with respect to **b**.

A shorthand notation is

$$\text{Find } \mathbf{b}^* = \min_{\mathbf{b}} S(\mathbf{b})$$

where **b*** is now the minimal (optimal) point in the n dimensional space of the parameters. If n is bigger than 3, it is hard to visualize this space. Even when $n = 2$, the function must be drawn as a contour map, i.e. rising out of the paper. This is one of the difficulties presented by optimization for beginners.

So far, we have stated the optimization problem as a minimization. What if we want to maximize an objective function? We can avoid the need for two programs, one to maximize and one to minimize, by noting that maximizing S(**b**) is the same as minimizing −S(**b**). This is illustrated, along with some other situations that arise in optimization, in figure 1. A function in one parameter is used to preserve simplicity.

In figure 1, the optimal point is labeled $b_M$. (We can drop the vector notation because we have only one parameter.) The figure also illustrates the possibility of a local minimum at $b_L$. In this example, $b_M$ is the global minimum of S(b) and the global maximum of −S(b). The point $b_S$ is a stationary point of the function where the slope of the curve is zero.

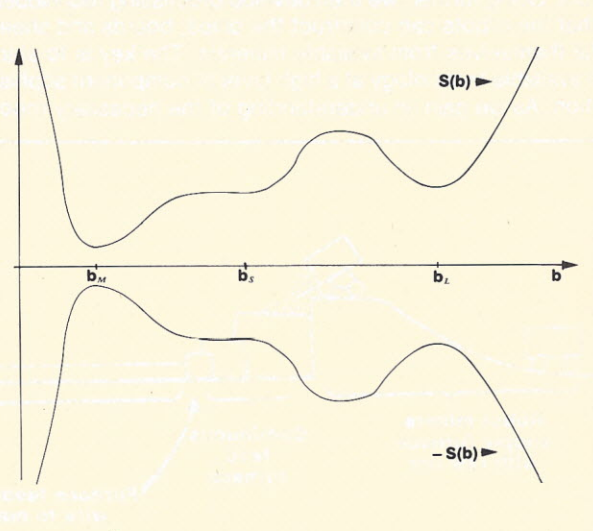


**Figure 1. Optima and stationary points**

$b_M$ is the global minimum of S(b) and the global maximum of −S(b). $b_L$ is a local minimum of S(b) and a local maximum of −S(b). $b_S$ is a stationary point of both functions.

Obviously, the slope of the curve is potentially useful to us. Intuitively, we can follow the slope "downhill" to a local minimum. From differential calculus, we can compute the slope or gradient of the first derivative of the function with respect to the parameter b,

$$S^1(b) = dS(b)/db$$

A necessary condition for a local minimum is that the gradient $S^1(b)$ be zero. However, $S^1(b_S)$ is zero, yet $b_S$ is definitely not a minimum point. A further condition that must be imposed is that the second derivative of S with respect to b is non-negative at the point of interest

$$S^{1,1}(b) = dS^1(b)/db = d^2S(b)/db^2 \geqslant 0$$

There are a number of interesting cases where the minimum is not unique—for example, where the function has a "flat bottom", or where several orders of derivatives vanish simultaneously (e.g. $S(b) = b^8$). For practical purposes, however, the theorems of differential calculus serve more as a guide to the development of numerical methods and do not yield useful programs themselves.

The same ideas carry over to the problem of minimizing a function of several variables, except that we now need partial derivatives. I will use the following notation

$S^{(i)}(\mathbf{b})$ = first partial derivative of the function S(**b**) with respect to $b_i$, evaluated at the point $\mathbf{b} = (b_1, b_2, \ldots, b_n)^T$.

$S^{(i,j)}(\mathbf{b})$ = second partial derivative of S(**b**) with respect to $b_i$ $b_j$, evaluated at the point **b**.

To make life even easier for ourselves, we can collect the first derivatives together in a vector

$$\mathbf{g}\,(\mathbf{b}) = (S^{(1)}(\mathbf{b}), S^{(2)}(\mathbf{b}), \ldots, S^{(n)}(\mathbf{b}))^T$$

which is called the *gradient* at **b**. Frequently, we will omit the explicit mention of the functional dependence of the gradient on the parameters **b** and write the gradient simply as **g**.

Likewise, the second derivatives (partials, of course) can be collected together in a matrix, H(**b**), called the Hessian. That is,

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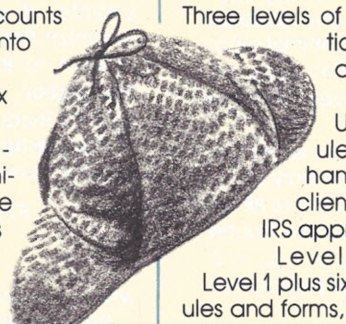

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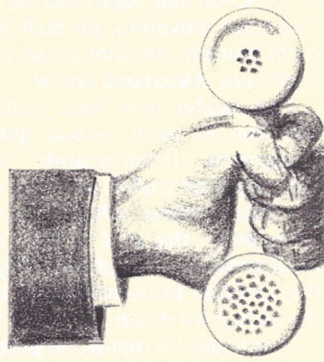

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$$H_{ij}(\mathbf{b}) = S^{(i,j)}(\mathbf{b})$$

The Hessian is again a function of the parameters.

The necessary conditions for $\mathbf{b}^*$ to be a local minimum of $S(\mathbf{b})$ are

$\mathbf{g}(\mathbf{b}^*) = \mathbf{0}$ (i.e. $\mathbf{b}^*$ is a stationary point)
$H(\mathbf{b})$ is positive semi-definitive, that is
$\mathbf{x}^T H(\mathbf{b}^*)\, \mathbf{x} \geqslant 0$ for any non-null vector $\mathbf{x}$.

The meaning of these conditions is as follows. It implies the function has a surface with a "flat" point at $\mathbf{b}^*$. If a marble were placed on a plaster model of the surface at $\mathbf{b}^*$, it would stay there unless disturbed. This flat point could be the top of a "hill," however, so even a little perturbation would send the marble rolling away from $\mathbf{b}^*$. It indicates that directions away from $\mathbf{b}^*$ are all "uphill." Thus our marble will return to $\mathbf{b}^*$, even if disturbed slightly.

These results from differential calculus are useful in helping us to think about optimization problems. Occasionally, they permit us to solve for an analytic expression or formula for $\mathbf{b}^*$. But, they are mostly useful as concepts rather than in practice.

In particular, many functions of interest may be discontinuous or have discontinuous derivatives. The real-life origins of such discontinuities are that certain parameters only cause changes in discrete jumps. For example, if a parameter represents storage capacity in a grain transportation system, the function may have discrete steps corresponding to the fact that grain elevators are built in units of whole elevators, not parts thereof. Another cause of discontinuities is constraints, which are discussed below.

The reader may have noticed a subtle omission of the question of local versus global minimum in the last few paragraphs. Unfortunately, techniques for finding global optima are difficult to develop, and practitioners usually search for local optima, which are then tested for acceptability. Frequently, the goal is not "best" but "better," so that a local minimum will suffice. Only by knowing a great deal about the function to be minimized is it possible to be certain that the global minimum has been found.

Practically no real-world problem can be stated correctly as a true unconstrained minimization of a function. (Henceforth we will not bother to mention the maximization alternative, but assume that the conversion of a maximization problem to a minimization problem by changing the sign has already been performed.) Real problems have constraints on the variables. For example, the quantities of feed making up an animal ration must be non-negative. The sizes of production runs are bounded; the sums of money available for investment are limited in some way.

Let us consider some specific constraint types and some examples. Inequality constraint: Many constraints only act as limits or bounds on the parameters. They are not active all the time. Such an inequality constraint may be a simple bound: $b_1 \leqslant 4$, $b_2 \geqslant 0$, or a linear inequality: $2\,b_1 + 3\,b_2 + 4\,b_3 \leqslant 5$. More generally, if $c(\mathbf{b})$ is a nonlinear function of the parameters, we can write

$$c(\mathbf{b}) \leqslant 0.$$

Note that the right-hand side of the inequation is always 0, and the relationship is always "less than or equal to," since we can adjust the funtion $c(\mathbf{b})$ to have this form in all cases. This is accomplished by balanced operations on both sides of a stated inequality constraint expression.

As an example of a nonlinear inequality constraint, consider the problem of launching a satellite into Earth orbit. Clearly, one constraint is that the satellite position must always be above ground. Normally, we would use polar coordinates, so that the radial distance of the satellite from the Earth's center is represented by r. However, let us use rectangular coordinates x, y in the plane of the satellite orbit. Clearly, since the mean Earth radius is 3,960 miles, we want

$$r^2 = x^2 + y^2 > 3960^2.$$

The "greater than" relationship is awkward in solution methods, but we can easily decide that 4,000 miles from the Earth's center is the lowest altitude allowed for the satellite. Thus

$$x^2 + y^2 \geqslant 4000*4000 = 1.6E+7$$

or

$$1.6E+7 - x^2 - y^2 \leqslant 0.$$

Letting $x = b_1$ and $y = b_2$ we have in the form needed above

$$c(\mathbf{b}) = 1.6E+7 - (b_1)^2 - (b_2)^2 \leqslant 0.$$

When there is more than one inequality constaint, we simply number the functions $c_1(\mathbf{b})$, $c_2(\mathbf{b})$, ....

There may also be equality constaints. For example, the flows of grain in the grain transport system must balance (Kirchoff's laws in electric circuits); the rocket launching the satellite must obey Newtonian mechanics. Such constraints can in general be written

$$q(\mathbf{b}) = 0$$

where $q(\mathbf{b})$ is some function, possibly nonlinear, in the parameters $\mathbf{b}$. Each equality constraint allows us to reduce the dimensionality of the optimization problem if we can solve the equation defining the equality constraint for one of the parameters in terms of the rest. This is usually easier said than done. For example, if our satellite were constrained to occupy an orbit 9,000 miles from the Earth's center, the constraint would be

$$q(\mathbf{b}) = b_1^2 + b_2^2 - 8.1E+7 = x^2 + y^2 - 8.1E+7 = 0$$

This can be solved for either of $b_1 = x$ or $b_2 = y$ in terms of the other parameter. Suppose we choose to eliminate $b_2$. Then

$$b_2 = +SQRT(8.1E+7 - b_1^2) \text{ or } b_2 = -SQRT(8.1E+7 - b_1^2)$$

where SQRT is used to denote the square root function. Note that now we must work with both possible substitutions for $b_2$, depending on the position of the satellite, which makes some of the expressions for the objective function rather messy.

Alternatively, an equality constraint may be represented as a pair of inequality ones,

$q(\mathbf{b}) \leqslant 0$
$-q(\mathbf{b}) \leqslant 0$ that is $q(\mathbf{b}) \geqslant 0$.

This allows a simple expression of the general optimization problem.

Now that we have an objective function and some constraints, it is possible to state our problem as follows: Minimize the function $S(\mathbf{b})$ with respect to the parameters $\mathbf{b}$ subject to K constraints $c_j(\mathbf{b}) \leqslant 0$, $j = 1, 2, ..., K$. In this formulation, we have subsummed the equality constraints into the inequality constraints by the method of creating pairs of inequalities for each equality. A shorthand notation for the general minimization problem is

$$\text{Find } \mathbf{b}^* = \underset{\mathbf{b}}{\text{Min}}\, S(\mathbf{b}) \text{ subject to } \mathbf{c}(\mathbf{b}) \leqslant \mathbf{0}$$

where we now have collected the constraints into a vector.

Since most numerical methods are based on unconstrained minimizations, we now need a way to convert the constrained problem into an unconstrained one. The technicalities of most such transformations are beyond the scope of a column such as this, but it is worth noting a couple of simple techniques that have been found effective.

One way to impose inequality constraints is to make the objective function take on a very large value whenever a constraint is violated. This barrier function approach redefines the optimization as follows:

Minimize $Z(\mathbf{b})$ with respect to $\mathbf{b}$ where
$Z(\mathbf{b}) = S(\mathbf{b})$ wherever $\mathbf{c}(\mathbf{b}) \leqslant \mathbf{0}$ (i.e. constraints not violated or inactive) and
$Z(\mathbf{b}) = L$, a very large number, wherever one or more of the constraints is violated (active).

Clearly, a solution of the unconstrained minimization of the

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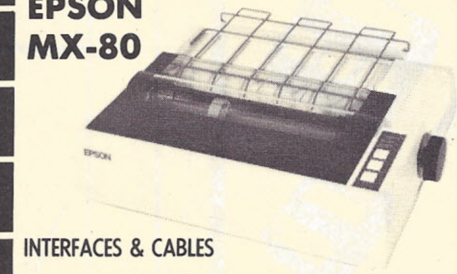

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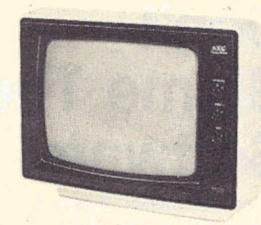

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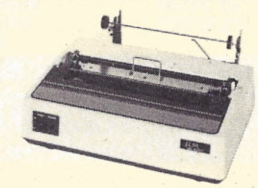

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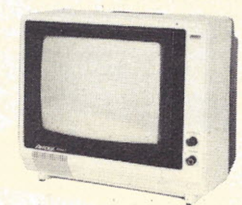

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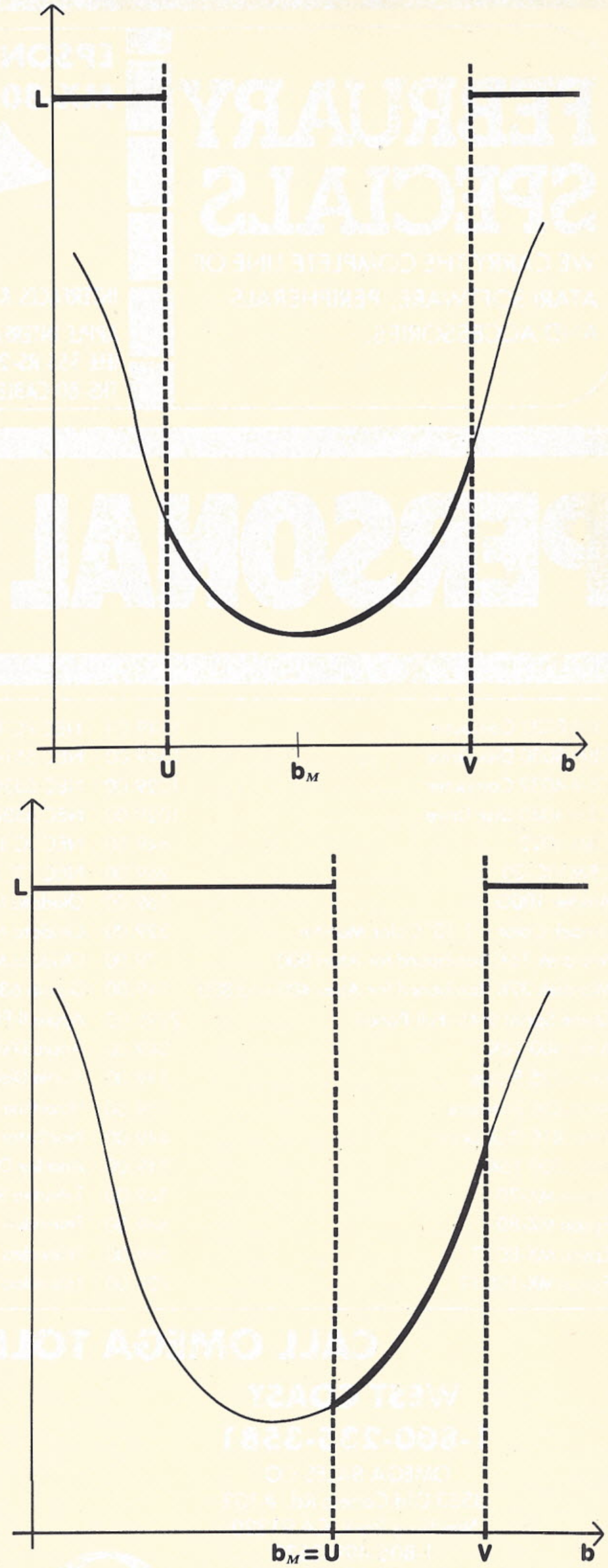



**Figure 2. Constraints**

$$c_1(b) = U - b \leq 0$$

and

$$c_2(b) = b - V \leq 0$$

are imposed on the function S(b) (thin line) by using a barrier L whenever the constraints are violated.
(a) constraints are inactive at the minimum.
(b) constraint $c_1$ is active at the minimum.
The thick line represents the function Z(b) of which the unconstrained minimum is the constrained minimum of the function S(b).

function Z(**b**) is equivalent to a constrained minimum of S(**b**). This is illustrated in figure 2.

A similar concept is that of a penalty function. Suppose there are r equality constraints

$$q_j(\mathbf{b}) = 0, j = 1, 2, 3, \ldots, r$$

and K inequality constraints

$$c_i(\mathbf{b}) \leqslant 0, i = 1, 2, \ldots, K$$

It is obvious that if $q_j^2(\mathbf{b})$ (the square of the constraint function for the $j^{th}$ constraint) is added to the objective function S(**b**), the constraint is not going to alter the objective when it is satisfied. When the constraint is violated, the function $q_j(\mathbf{b})$ gives a measure of "how much" it is violated, and the penalty for violation of the constraint is the square of this value. In some ways, violating a constraint is like a murderer only killing someone a little bit, but the penalty function approach has been used successfully by a number of practitioners of optimization.

For inequality constraints, if we approach the constraint boundary from a point where the constraint is satisfied (a feasible point), then adding a penalty

$$v_i/c_i(\mathbf{b})$$

where $v_i$ is some weighting constant, will make the derived objective function very large as the boundary defined by

$$c_i(\mathbf{b}) = 0$$

is approached. An easier alternative is to add the square of the constraint function whenever it is positive (i.e. violated), just as in the equality constraint case. Using this latter approach, and applying weights $w_j$, j = 1, 2, ..., r to each of the equality constraint penalty functions, and weights $v_i$, i = 1, 2, ..., K to each of the inequality constraint penalty functions, we have the general penalized objective function

$$Z(\mathbf{b}) = S(\mathbf{b}) + \sum_{j=1}^{r} w_j\, q_j^2(\mathbf{b}) + \sum_{i=1}^{K} v_i (c_i(\mathbf{b}))^2\, h(c_i(\mathbf{b}))$$

where h(x) is the Heaviside step function defined as

$$\begin{aligned} h(x) &= 1 \text{ for x positive} \\ &= 0 \text{ otherwise.} \end{aligned}$$

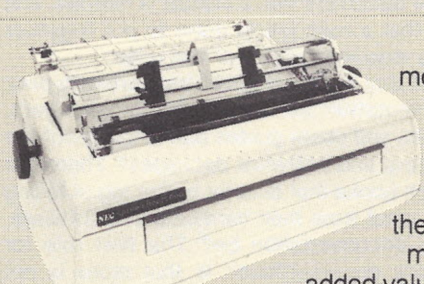
The Heaviside function "switches on" the penalty for the inequality constraints. As the weights $w_j$, $v_i$ are made large, it is obvious that the solution of the unconstrained minimum of Z will approach the constrained minimum of S.

The utility of barrier functions is diminished in that they create discontinuities in the derived objective function, which disrupt the operation of gradient methods of function minimization programs that do not assume a smooth functional surface.

Penalty functions require us to provide weightings for the constraints. In general, we must solve several unconstrained problems to approach the constrained minimum as the weightings are made larger and larger. Note that we always get only an approximation to the desired solution. Also, the large numbers introduced by weightings required to force specific constraints to hold and force a good approximation to the desired minimum may result in badly scaled objective functions for the unconstrained minimizations. Most function minimization methods solve poorly scaled problems less efficiently than well scaled ones.

The short overview of optimization presented here is only a sample of the whole field. In future columns, I hope to explore various aspects of the subject. Next month, I will present a short but reasonably effective search technique and include a program that implements it. In a later column, I will discuss the relationship between optimization in the sense described here, and the related problems of nonlinear least squares fitting, sets of simultaneous nonlinear equations, and the inaptly named topic of mathematical programming. □



# Learning with Micros

by Louis E. Frenzel

### Using Documentation

There are three basic parts to every microcomputer system: hardware, software and documentation. While documentation has gotten better over the years, it still leaves much to be desired. Hardware and software manufacturers are overdue in giving greater attention to this important part of the system.

Microcomputer documentation includes the user guides and instruction manuals supplied with the equipment. Microcomputer documentation is usually made up of printed materials that tell the user how to operate the system. Documentation may be in the form of step-by-step instructions, or it may be simply a reference manual containing charts, tables and lists.

There are usually several different levels of documentation available. The first is what you might call simple, start-up instructions that give the user a shortcut to using the hardware or software. The second level encompasses the detailed operating and user instructions. Here the operation is more thoroughly explained and often specific examples are given. The last level is the reference material. This might be the CPU instruction set, programming language command and statement details, hardware operation theory with logic diagrams and schematics, or tables like hex-to-decimal conversion or the ASCII code.

In a lot of cases, the documentation seems to be an afterthought. When the computer has been designed and is ready to manufacture, or when the final software has been tested and verified, someone discovers that a manual is needed. It is usually at that point that a rush job is done to put together some kind of suitable documentation for the user.

I don't think there is any question about the generally poor quality of the documentation for today's microcomputers. Why are so many books and users guides published about the most popular computers and software packages? There are literally dozens of such books that do a far better job of telling users how to get the most from their hardware and software.

What should good documentation be? The first rule for hardware and software documentation is that more is not better. Many manufacturers feel that the more information given, the better it is for the user. But, just the opposite is true. Most users hate to read and simply will not wade through hundreds of pages of even the finest documentation. Manufacturers must find ways to shorten the documentation and concentrate it into a form that is more palatable to the user. There is a much better chance that the user will read several pages than hundreds of pages. Every effort should be made to condense the key information into the smallest possible space.

Also, hardware and software should be as self-documenting as possible. Self-documenting refers to the fact that the hardware and software themselves contain the instructions. For example, in the hardware, directions can be stored in the operating system or language ROMs. These can guide the user step-by-step in the beginning stages, so that it is simply not necessary to refer to the documentation.

The same is true of software. There is no reason why step-by-step instructions cannot be built into the software to guide the user at all points. There is a trend toward more menu-driven software and user-friendly hardware. Memory is cheap these days, so there is no reason why most of the key documentation cannot be built-in.

In addition, other forms of media should be considered. While most documentation is in printed form, perhaps other formats and media would work better. For example, why not put the documentation on audio tape? Inexpensive audio cassettes could contain a lot of the instructions for using hardware and software. The user would simply play a tape that would explain the use of the hardware or software. Many users will listen to a tape when they wouldn't read a book.

One of the biggest issues in microcomputer documentation is the question of whether it should be training or reference material. There are those who support the theory that the manufacturer's responsibility is only to provide enough information about the system so that a knowledgeable user can benefit. Such documentation is primarily reference material. The manufacturer assumes that the user has some experience in operating and using microcomputers. Therefore, all that is needed is specific information about the particular computer or software package.

Another group feels that microcomputer documentation should be educational. A lot of first-time users have the feeling that it is the responsibility of the manufacturer to teach them how the microcomputer or software operates. In this case, reference material is simply not enough. The documentation must supply adequate training to give the user a full understanding of the system, as well as step-by-step operational instructions.

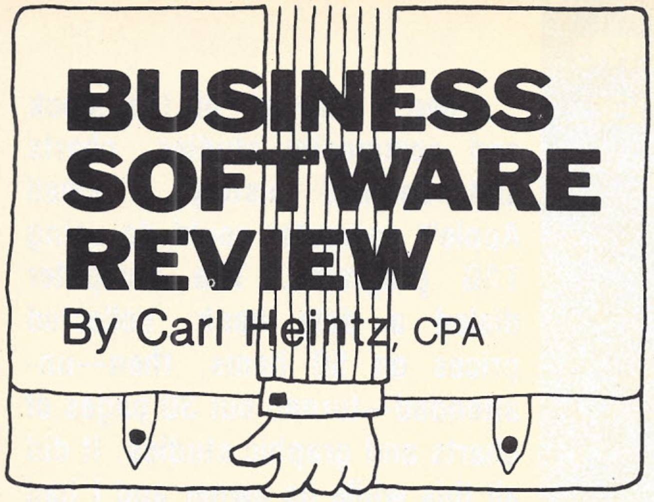
In a sense, both arguments are valid. The experienced user will probably neither take the time nor make the effort to go through documentation that is a training program. He wants to make immediate use of the system, and therefore prefers concise reference material that gets him going fast. Anything else would be frustrating.

On the other hand, first-time users don't know where to begin and generally appreciate documentation that is basically a self-study course on the specific hardware or software.

One compromise approach would be for the manufacturer to provide reference documentation with the hardware or software. This is the basic information required by both beginning and advanced users. The educational documentation would be sold as a separate product. The manufacturer could make additional money by selling this material. After all, it is more difficult to develop good instructional documentation. Most beginning users are willing to pay for it.

Perhaps one key to getting first-time users to read documentation is to put it into a self-instruction format. By using audio tapes, programmed instruction, and brief self-instructional sequences with practice problems and self-checking exams, users will be more inclined to use it.

One final point: today some software packages and hardware devices are so complex that even the best of reference documentation is insufficient to bring the user to a competent level. Big software packages such as languages, operating systems, and some applications programs have such depth, breadth and sophistication that only an experienced person can use them. For other users, some formal training is needed. I have often felt that it is difficult or sometimes even impossible to develop adequate documentation for such complex hardware or software. It may be more realistic and desirable for the manufacturer to offer formal training programs. In-store classes or seminars may be the best way to train the user on such hardware or software. It could be that a lot of the criticism of documentation is unwarranted simply because the documentation may *never* be adequate to take the place of what is really needed—a formal class or seminar. □




### Versatile Accounting Package

This month's column focuses on a series of accounting programs produced by Designer Software, Houston, TX. The packages are marketed under the Palantir trademark. The accounts payable and general ledger packages are designed for Z80-based machines, and are distributed on 8-in. single-density disks.

The most unusual features of the systems are the manuals. Without a doubt, they are the most unusual computer manuals to be found. The differences are apparent when one considers the contents:

| | |
|---|---|
| Welcome to Smallville | Introduction—the 19th Hole |
| Getting Started Checklist | A Note to the Impatient User |
| Organizing the Workflow | Sidney Learns About Debits |
| The 12 Commandments | An Introduction to Double Entry Bookkeeping |

The manuals actually contain two sections each: a folksy discussion of the program, and an imaginary installation. They are fun to read since they are anything but dry. Entertaining, yes; great fiction, no. The manuals are fairly well organized and targeted for an audience not necessarily familiar with the computer. The manual assumes that the user knows how to turn on the machine and that's all. They contain extensive documentation on what the programs do and why. Additionally, the manuals use several different type fonts and other printing conventions, such as boxes and bold print, to emphasize points.

One of the best features of the series is the step-by-step checklists furnished for all of the functions. There's a checklist for getting started; one for daily, monthly, and closing procedures; and one for year-end procedures.

As a reviewer, I've become very jaded about general ledger packages. They all seem to be designed by non-accountants who have very little, if any, knowledge of what it is that users (and especially CPAs) need from general ledger systems. The Palantir software is different.

To begin with, the general ledger account can be up to ten digits long—either numbers or letters. You don't have to use ten, but if you are a hospital, for example, it is sometimes mandatory to have account numbers that long. Ten digits is more than sufficient to meet the needs of any regulatory agency or in-house requirement. The choice of numbering system is entirely up to the user, which is another great freedom. The general ledger contains transaction activity for a full 12 months, another real advantage. Additionally, the system is one of the few general ledger systems with a true sub-account scheme that works. It's just like having a manual set of books from the standpoint of flexibility in setting up and arranging accounts.

The Palantir system has an excellent journal entry process. The information input to the files includes: Date of Journal Entry; Journal Entry Batch or Reference Number; Date Entered (i.e. when operator put it in); Made By; Description; and Amount.

The journal entry program also has some built-in checks and tests to prevent "junk" from being entered. Among these tests are a check to determine that each journal entry account number exists, that for each account number entered, there is at least one debit or a credit, but not both. Note that the system does not have any checks to determine whether or not the entry is in balance—one-sided entries are possible. While from an accountant's standpoint, this is not a good feature, the authors of the Palantir system make a good argument that if something happens to the computer or the books are out of balance, a one-sided entry might be necessary. Most accountants would prefer a limitation on one-sided entries—it's just too easy to get an entry out of balance. Additionally, when the system checks for out-of-balance journals, there is a tendency to catch transposition and keypunch errors easier.

Journals are entered in batches. After each entry batch is input, a hard-copy printout is made. This is an excellent control, since it assures the user that everything that went into the computer is on a piece of paper somewhere. The system will put an error message next to any journal entry that is out of balance. The operator can review the entries by looking at them on the screen or scanning the hard-copy printout. When and if errors are found, they can be corrected —directly—by using an editor program that allows you to change the entry, line item by line item.

Once the entries are in a form wherein they can be posted, you can do so by selecting the update function. Journal entries can be posted to prior months with this system, which has the major advantage of allowing financial statements for the month to be free from prior months' adjusting entries (always a source of annoyance to accountants who have a hard time explaining to clients why the computer messed up the current month's figures).

Once updated, the journals become part of the general ledger system and can be viewed on the CRT (as part of an inquiry system). The next step is the presentation of a trial balance, a step that is fundamentally important in determining that the figures in the general ledger make sense. The Palantir system has an excellent format for the generation of a trial balance that is readable and workable. Coupled with the ability to investigate the balances in each of the general ledger accounts on the computer, the system is outstanding.

### Flexible financial statements

Most general ledger systems include a pre-formatted financial reporting system that leaves the user with only elementary choices in the construction of a financial statement. In some cases, the statements produced by these systems are inferior to those that could be easily generated manually, and the whole point of computer implementation is somewhat of a loss. With the Palantir system, the user has complete flexibility in the design and construction of the financial statements. That is because the system does not include any pre-formatted financial statements—the user has to roll his own, using a sophisticated report writer included in the package. Included are the abilities to: subtotal and total at will; underline and double underline; use titles and headers on pages; number pages; print descriptions as dictated by the user; generate ratios; prepare up to four column reports; combine accounts; and compute ratios.

The report-writing program gives the user the opportunity to create informative reports that are over and above the normal balance sheet and profit/loss accounts. This flexibility allows the user to generate some management reports that would have been impossible with other systems.

The system is not easy to use, and will take a few hours to master. From a user standpoint, the software authors recog-

nized this and attempted to make the introduction to it simple —it still takes a few tries and a lot of practice to get it right. The benefit is that the resulting financial statements are really custom-looking—with a word processing printer (such as an NEC), the statements look like they were hand-typed.

One of the nice features of the general ledger system is that it allows the user to keep year-to-date information. Most other popular systems don't allow this. Instead, they force the user to employ a carry-forward system, purging the last month's detail before the current month's detail can be added. The Palantir system leaves this option up to the user, and, accordingly, satisfies one of the major pitfalls of many computerized systems. With a small company, it is reasonable to assume that up to one year's worth of detail may find itself

***General ledger packages... seem to be designed by non-accountants... The Palantir software is different...***

stored on the system. But with any volume of activity at all, it is more likely that after a few months, the information will have to be purged, and the balances carried forward in the ledger as balance forwards. Still, having only two or three detail records for the year is a lot easier than having 12.

The general ledger program is a good one. It runs fairly fast, and has many features that make it applicable for the small company or accountant in private practice (CPA).

The accounts payable system is a simple yet complete method for processing accounts payable and the related cash disbursements. The system offers password protection and integral data security. The reports offered are comprehensive and useful in the administration of an organized purchasing function. As the general ledger manual pointed out, the programs have a very unusual manual—a combination of folksy dialogue and down-to-earth implementation guidance.

The average accounts payable program is essentially a system for the entry and manipulation of invoice information. As invoices come due for payment, the system should produce checks. Additional functions should include some form of vendor file maintenance, an aging of what is due, and some form of preparing summaries from the system to make entries in the general ledger. Of course, one of the most important products of the accounts payable system is the check register, indicating the check numbers, their amounts and payees.

The Palantir system is designed to accomplish all of these features, and has other features that increase its usefulness. These include: aging of open invoices by invoice date; automatic updating of the general ledger; maintenance of year-to-date purchases and payments by vendor; preparation of separate check registers for hand-written and computer-generated checks; and automatic generation of an audit trail, including all transactions and modifications made.

Unfortunately, the system does not handle cash discounts very well. In some programs, the computer will calculate the discount automatically. With this system, the dollar amount of the discount must be entered. This could lead to errors, or the omission of discounts being taken. Also, the system always pays net of the discount, regardless of the time wherein the discount is applicable. These are minor problems, and one might consider them personal preferences.

The system has an efficient method of distributing payment, allowing up to 14 different accounts to receive amounts. In fact, with a little ingenuity, an almost unlimited distribution could be done.

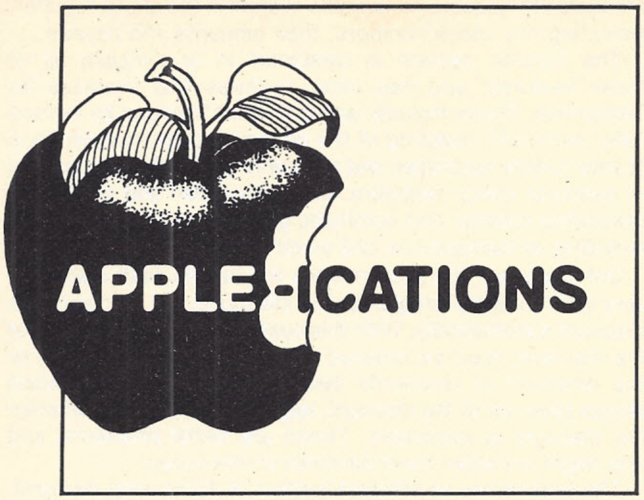
The programs produce a nice aging of the open invoices by invoice date. Missing are agings by vendor or by account distribution. The system generates a cash requirements report that summarizes the cash-flow requirements for the upcoming weeks: it is well-laid-out and easy to work with. The system can cope with partial payments on invoices, and has the expected capacity to deal with credit memos. Additionally, the system can respond to the need to issue manual checks, and even prepares a separate check register for them.

When writing checks, the system generates its own check numbers. These are assigned to the checks (NEBS forms used), and a record of the checks is prepared in a check register. With this general ledger system, the user can have the accounts payable system update the general ledger automatically.

One of the nice features of the system is the extensive use of checklists and forms to utilize in the system implementation.

Missing from the inventory system are job-costing capabilities. When manufacturers use the system, they may well have a need to isolate costs by more than just general ledger account number. Very often, a job number is required as part of a job cost system. While there may be some way to produce this by using a combination of account numbers, it would be inflexible at best. No system can have everything.

The Palantir system appears to be a reasonably good accounts payable system that could be implemented successfully in many micro applications sites. □




by Cary Clark

**Sound Generation on the Apple**

Both the Apple II and the Apple III have built-in speakers that are capable of a wide variety of sounds. The Apple III allows the sound to be routed to an external sound system. But what kinds of sounds can be produced? And how can one produce them?

The Apple II speaker, although originally not intended to produce anything more than the familiar "beep" that accompanies DOS and Basic errors, has been used to create a wide variety of sounds for both educational and entertaining applications. In order to keep the circuitry as simple as possible, the "beep" ability was designed around software instead of hardware. In order to produce a 1 kHz tone for .1 second, a routine in the monitor toggles a particular location in memory, $C030, which is decoded and hooked up through a Darlington amplifier circuit to drive an 8-ohm speaker.

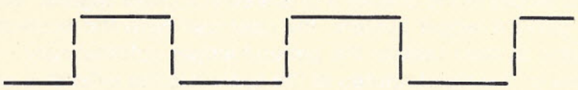


**Figure 1. Square wave formation**

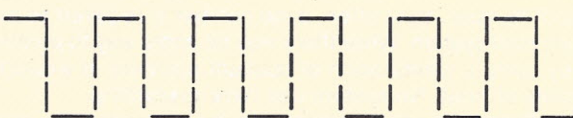


**Figure 2. High-pitched sound wave**

Since this interface was designed to mimic tone-generating hardware, the speaker can only be toggled. In other words, when the speaker location is referenced, the speaker's cone position is moved out if it was in, or moved in if it was out. This in-and-out, out-and-in movement makes a sound wave that looks like that depicted in figure 1. This waveform is called a square wave because the ends are squared up; in practice, the limited ability of the speaker to produce the wave causes the corners to be rounded.

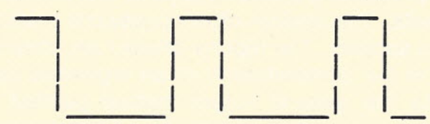
Sounds generally have three components: pitch or frequency, volume or amplitude, and tone or quality. Under software control on the Apple II, one can control two of these parameters. On the Apple III, all of these parameters can be dynamically varied. On both machines, the pitch of a given sound can be changed by accessing the speaker more or less frequently. A high pitched sound should look like figure 2, while a lower pitched sound would look like figure 3.

The lower pitched sound was generated by accessing the speaker half as often as the higher frequency. For the musically minded, this lower pitched sound is exactly one octave lower than the previous sound. Pitch is determined by the frequency of speaker access.

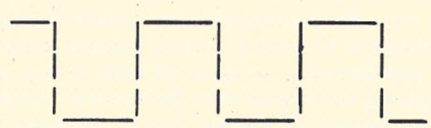
All sounds that one hears can be thought of as a culmination of simple sounds, just as an orchestra is a culmination of fairly simple sounding instruments. Traditionally, the building block of all sounds is the sine wave, which is what AC current looks like. Its frequency or pitch is measured in cycles, which is how many times the wave goes up and down in a second. Sine waves are hard for computers to make, so square waves are used as the basic building blocks instead. Square waves look and sound much like sine waves, so they are basically a good choice.

To hear built sounds in action, listen to your own voice. Your vocal cords produce a complex sound with many components that your mouth can modify by subtracting out parts of the overall sound. This is called subtractive synthesis. Although you may think of your voice as a simple pitched sound, if you listen to it carefully, you can hear the various pitches at different volumes, which make up the various vowel sounds. A somewhat more unusual experiment is to remove the phone handset off the hook and cover the earpiece with your mouth. As you open and close your mouth, you can hear the various components of the dial tone quite clearly, although to the casual observer, the dial tone appears to be a simple pitched sound.

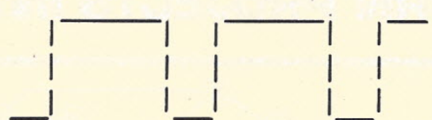
**Figure 3. Low-pitched sound wave**



**20% duty cycle**



**50% duty cycle (square wave)**



**80% duty cycle**

**Figure 4. Various pulse widths**

Neither the Apple II nor III is able to directly do subtractive synthesis, yet the Apple III is able to do a different kind of synthesis. So how can the Apple produce different tones?

The square wave is just one member of a family of waveforms called pulse waves. Pulses can have different widths; these widths are also called duty cycles. Figure 4 illustrates three different pulses. The thin pulses sound reedy, like you sound if you hold your nose and talk. The square wave sounds more full, like an oboe or a musical horn. All three have the same frequency, since they take the same amount of time to repeat the waveform; but since they have different shapes, they are made up of different proportions of sounds. So they sound different. However, the thin 20% duty cycle pulse sounds the same as the 80% duty cycle pulse. If that doesn't sound right, try standing on your head and seeing if the world sounds upside-down.

The Apples can vary the harmonic content or the building blocks of their sounds by generating different widths of pulse waveforms. In fact, all Apple II sounds can be described as a secession of various pulses at various frequencies. Apple III sounds can be a good deal more varied than the Apple II. The Apple III speaker circuitry has two options: it can be set up to act like the hardware tone generator that the Apple sound circuitry imitates, and generate tones independent of what the microprocessor is doing; or it can control the third attribute of sounds, amplitude or volume.

The Apple II has two possibilities for sound volume: all or none. The Apple III can output 64 different volumes. Amplitude

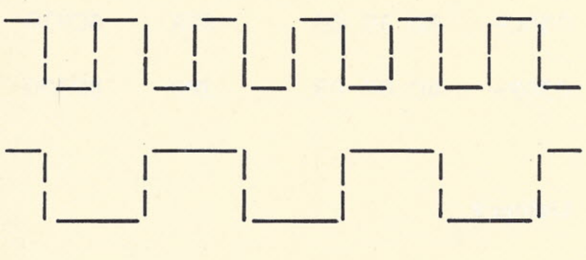


**Figure 5. Two waveforms to be produced**

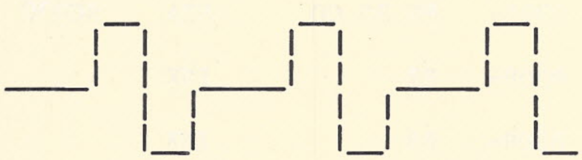


**Figure 6. Sum of two waveforms**

control is good for more than just varying volume; it can be used to produce tones and chords as well. Let's suppose that you want to produce the two waveforms in figure 5 simultaneously. To do so, you need to produce the sum of both waveforms, illustrated in figure 6.

This resultant waveform requires three levels of amplitude to produce. Thus, the Apple III is able to produce many simultaneous tones. A more variable amplitude also allows more flexibility in constructing waveforms with varying harmonic contents. This method of creating different tonal qualities is called additive synthesis.

One simple experiment to find out what a variety of sounds the computers can produce requires an Apple and a pair of game paddles or a joystick. On the Apple II, enter the monitor from either Integer or Applesoft Basic by typing

CALL −167<cr>

Then type the following

300:A2 00 20 1E FB 8D 30 C0 E8 20 1E FB 8D 30 C0 4C 00 03 <cr>

Typing 300L <cr> will display the disassembly in listing 1 if you typed it in correctly. This is a demonstration that was written by Bruce Tognazzini, identified with the names Multi-Tone Genie and Mini Assembler Tutorial. It appears in the Apple Education Series volume 3, *Apple How To.*

Now, type

300G <cr>

and turn the knobs. This is a good example of how versatile pulses can sound. The same experiment needs to be modified somewhat for the Apple III in Emulation mode. First, connect your joystick or paddles to port B. Next, boot the Apple II Emulation diskette. Select Integer Basic, boot the drive, depress reset, then type in

CALL −167 <cr>

300: A2 00 20 13 03 8D 30 C0 E8 E8 20 13 03 8D 30 C0 4C 00 03 20 1E FB A8 EA 88 D0 FD 60 <cr>

Then type

300L <cr>

and you should see the disassembly in listing 2. A different program is required on the Apple III because its paddle circuitry is much faster than that of the Apple II; too fast, in fact, for this program where delays are important.

Both programs are using the paddles or joystick to vary the delay between speaker toggles. Since the speaker is accessed twice per loop, each paddle measures the length of either the high or low portion of the wave. On the Apple II, reading the paddles too quickly results in every other reading being in error for each paddle, so additional strange sounds are produced as one or both of the paddles are turned to high readings (extreme clockwise). An excellent programming example of

how various pulse widths can be used for various tones is contained in the music generating portion of the Programmer's Aid, which is a supplement to Integer Basic.

Further sound experimentation may require some knowledge of the Apple's machine language instruction set; yet sound experimentation is a good way to learn assembly language programming through a tool like the Mini-Assembler in Integer Basic, or one of Apple's assemblers on the DOS Tool Kit or Pascal. Keep in mind that (with the disk drive door open) there is no damage that can be done to your computer by experimental programming. □

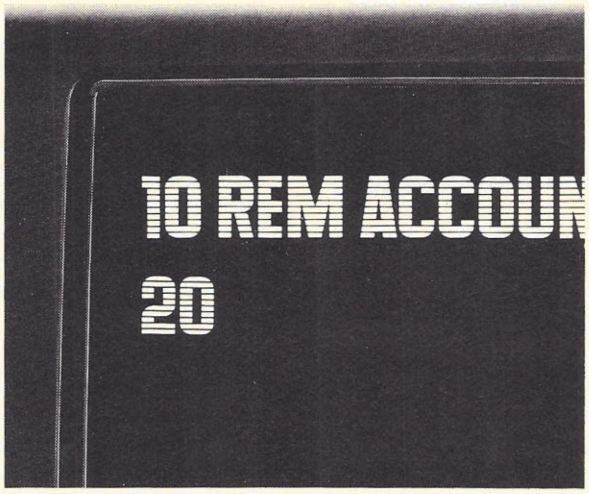
**Listing 1**

```
0300-   A2 00      LDX   #$00
0302-   20 1E FB   JSR   $FB1E
0305-   8D 30 C0   STA   $C030
0308-   E8         INX
0309-   20 1E FB   JSR   $FB1E
030C-   8D 30 C0   STA   $C030
030F-   4C 00 03   JMP   $0300
```

**Listing 2**

```
0300-   A2 00      LDX   #$00
0302-   20 13 03   JSR   $0313
0305-   8D 30 C0   STA   $C030
0308-   E8         INX
0309-   E8         INX
030A-   20 13 03   JSR   $0313
030D-   8D 30 C0   STA   $C030
0310-   4C 00 03   JMP   $0300
0313-   20 1E FB   JSR   $FB1E
0316-   A8         TAY
0317-   EA         NOP
0318-   88         DEY
0319-   D0 FD      BNE   $0317
031B-   60         RTS
```

# BOY, IS THIS COSTING YOU.

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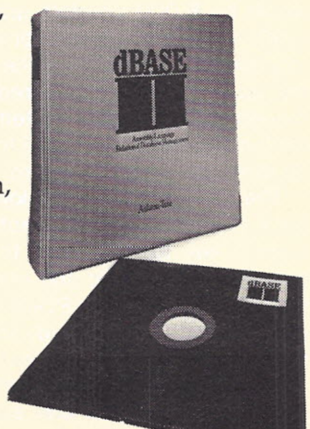



Ashton-Tate

# THE COMMODORE LOGBOOK

by Mike Heck

### Graphic Products Summary

While many people associate Commodore computers with their data processing capabilities in business, educational or personal applications, few realize the power inherent in the built-in graphic character set and functions. Following is an overview of graphic capabilities of Commodore computers, along with the concepts behind the system, and how one might take advantage of graphics in a myriad of applications. We will also touch on some add-on interfaces that allow high resolution graphics and plotting.

All Commodore systems, from the Vic 20 to the top-of-the-line SuperPet, contain the same Pet graphic character set. It is contained in ROM (read only memory), and is available immediately whenever the computer is turned on. The standard character set contains 64 special graphic symbols. These characters include various horizontal and vertical lines in different positions and corners, numerous shadings of various sizes, and special symbols—check marks, hearts, etc. All characters can be typed directly from the keyboard, accessed from a program through print statements, or POKED into screen locations, either directly or from within a program.

On each Commodore computer, a graphics mode chooses between upper/lower case characters or upper case/graphic characters. In the graphics mode, the characters are typed in the SHIFT position on the keyboard, since it is, in effect, an alternate character set. The graphic mode is designed to allow much higher resolution than would be possible with straight text characters.

Graphic characters occupy one-quarter of the cell, or pixel, that a full text character does. Thus, if you were using a CBM 8000 computer with 80 characters per line by 25 lines, there would be 8,000 possible graphic locations, rather than the 2,000 locations available for text characters. All of the 8,000 locations can't be used at the same time, but one can still plot denser graphics as compared to the normal text mode. Even though all Commodore systems contain the same graphic set, each computer is designed for different applications and has its own operating procedure.

The Vic 20 may be the lowest-priced Commodore model, but it contains the most graphic features. It contains an extra control key located next to the shift key, which toggles between the graphic and text mode when pressed with the shift key. By issuing a POKE 36869,242, one can switch the graphic mode to text mode from within a program, instead of using the graphic control key.

Each graphic character is etched on the front of the corresponding key, so one can easily create simple graphics for games or other applications from Basic print statements, without having to look up character codes in the documentation.

The Vic also allows each character, whether text or graphic, to be displayed in any of eight colors. The colors are selected by using the Vic's standard control key. The Vic also has the unique capability of allowing the character set to be redefined in any form desired. By redefining the characters, a high-resolution graphic screen of 176 by 184 pixels (32,384) maximum can be created. In this way, games or other applications that need high-resolution graphics can be created without any add-on interfacing.

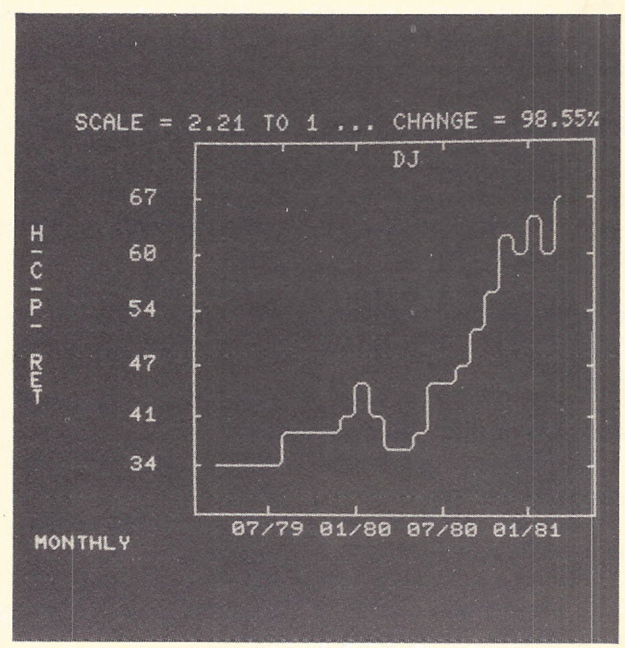
Since the text mode is only 22 characters by 23 lines, this ability to substantially increase the graphic resolution and create special characters is an important feature. For those interested in advanced graphics on the Vic, Commodore has a number of programs to make the job easier.

The Super Expander cartridge adds 3K RAM expansion, high-resolution graphics plotting, color, paint and sound commands in one unit. The cartridge may be set in graphic, text, multicolor or music modes. Super high-resolution 1,024 by 1,024 dot screen plotting is also possible. All commands may be typed as straight Basic commands or accessed by hitting one of the Vic's special function keys.

While not as sophisticated as the expansion cartridge, a Programmable Character Set/Gamegraphics Editor is also available. This program enables one to create up to 64 programmable characters and incorporate them in Basic programs. The editor takes only ½K byte of program space and is compatible with tape or disk. The resulting custom characters can also be printed on the Vic 1515 printer.

The Commodore Pet series computers operate like the Vic in many areas. Pet keyboards show the graphic symbols on the front of the keycaps. Pets are also normally in the graphic mode, displaying upper case/graphics. On the Pet, a command of "POKE 59468, 12" selects the graphic mode. Using the Pet graphic set allows increased resolution, because portions of the character cell are accessible. Even though it lacks the ability to turn on or off individual dots, sophisticated graphics are still possible.

The CBM 8000 series computers can also access the full Pet graphics. The only difference between CBM systems and

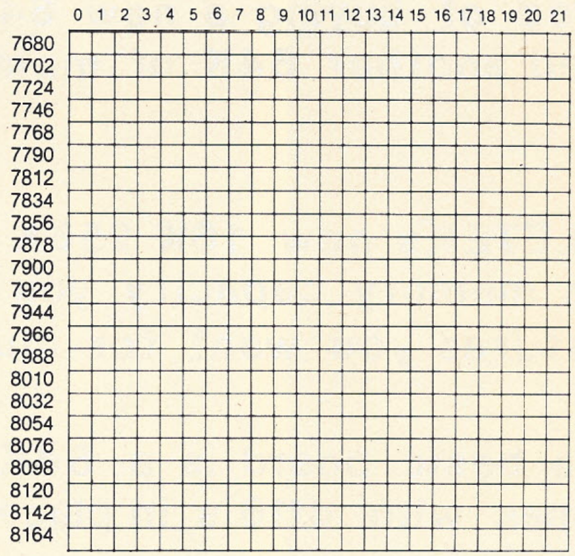



**Example of stock data chart**

the Pet or Vic is the keyboard. Since CBM computers are normally used in business applications, the graphic symbols are not placed on the keycaps. However, one can still type almost all the graphics from the keyboard, and all are accessible through POKES to screen locations.

Graphics find their way into almost all applications: Games would be dull without fast-moving animation; educators use graphics to make learning more interesting and reinforce course material; and business applications take advantage of the expanded information that graphics provide.

A business application could display information in graph form, so interpretation and analysis of data are much easier. The accompanying photo is a graphic representation of stock data and was plotted on a standard Pet. The programmer might use print statements consisting of the graphic line segments and corners to construct the chart or graph on both the screen and printer. Then, to place the information in the proper place on the screen, POKE commands would insert the information directly in the proper screen location.




**Screen character codes**

A special area of memory in each Commodore computer is set aside for the display screen. This is referred to as memory-mapped video. It means that each location on the screen is represented by a location in memory. By placing (POKING) the numerical representation of a character in the proper memory location, that character will be displayed in the specific location on the screen. Think of the computer screen as a gridwork that reflects the number of characters in width and depth on the screen. By using the grid as a guide during programming, one can make sure that the right character will be printed in the proper location on the display.

The advantage of programming graphics in this manner is that one gets direct access to individual locations, without disturbing neighboring characters. If simple Basic print statements were used, each line would be overwritten and unchanged data would have to be reprinted each time.

Because each Commodore system's screen memory is different due to the various screen formats, the Vic will be used as a short example of how screen memory maps and character codes might be used.

The Vic's 22-character by 23-line display can be represented by a box divided into 506 locations. For the Vic, the upper left corner represents memory location 7680, while the lower right corner is location 8185 (see figure).

If one knows the row and column where a character should be placed, the following formula will give the exact location:

Point = 7680 + ROW + 22 * Column

To place a character in the middle of the screen (column 10, row 10), the position would be 7910 (7680 + 10 + 220). Then type POKE 7910, code. For example, to place a closed circle in the above location, type: POKE 7910,81.

These same concepts would apply to programming graphics on any Commodore system. The only difference would be in the number of characters available on the screen and the actual memory locations. These figures and character codes for the POKES are listed in the documentation supplied with each computer. To do graphing, incorporate the above formula into program statements that would draw the line.

To get a bar that represents 50% of the display, type:

```
100 for x = 7900 to 7910
110 poke x,102: rem code for shaded square
120 next x
```

This would draw a shaded bar horizontally one-half the width of the screen on a Vic. It would be easy to extend this example, with additional formula, to format and graph data in the proper area on the screen, based on the range of data.

For certain applications, one may need more capabilities or higher resolution than the standard graphic set provides. In this case, a hardware add-on board will probably be necessary. One such unit is the MTU graphic package from Micro Technology Unlimited, Raleigh, NC.

Part of the package is the Integrated Visible Memory board, which offers high-resolution graphics for Pet/CBM computers. The board allows full control over a 320 by 200 dot matrix on the display. Additionally, it can be used as an 8K RAM board when the graphics are not in use.

Some features include: four types of video image control, five bank-switchable ROM sockets and an extended bus for further expansion. One expansion from the bus could be a disk controller. The board mounts inside the computer cabinet for maximum protection and portability. Power is supplied directly from the computer's power supply without disturbing the main CPU board.

Supplied Keyboard Graphic software adds almost 50 commands to Pet Basic. These commands permit selection of video and display modes, screen windows, text plotting, cursor control and shape table commands.

As shown earlier, to draw a line under normal Basic took a number of statements. With Keyword Graphics, a single DRAW command will draw a line from the current cursor position to a designated point. The LINE command will draw a line between designated points. The remaining commands work in the same manner. It is even possible to create and save standard characters and/or symbols and recall them with one command. In addition, an abbreviated command function allows 11 of the most-used commands to be executed with only a few keystrokes, for more rapid program execution.

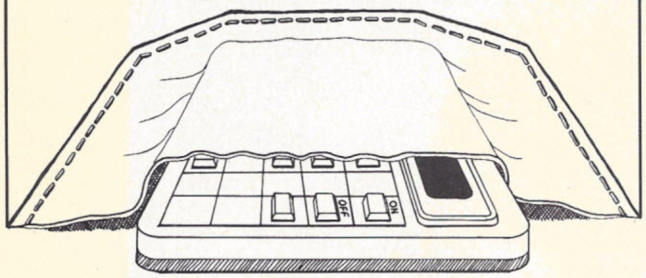
The MTU boards are designed to work with any Pet/CBM from the Pet 2001 to the CBM 8032. Merely specify which unit one has and which Basic ROMs.

One of the added benefits of the MTU board is the five ROM sockets that can be selected through software control. Since many software packages use ROMs either to hold extra coding or to offer software protection, this extra space is most welcome. Now one needn't have to continually unplug ROMs when using software packages on a regular basis.

Using graphics can be as simple or complex as desired. In some cases, it requires as much concentration as learning a high-level language such as Pascal or Fortran. But in many situations, one can use sophisticated graphics without much effort. It is wise to evaluate all packages being considered for the use of graphics. If possible, graphics should be an integral part of the program. □

# POWER IN YOUR POCKET

by Bob McElwain



## Experimenting with Sharp's PC

This month, I'd like to share some observations I've made while working with the Sharp/Radio Shack pocket computer.

All variable names are not equally accessible to this computer. Use W through Z for frequent or repetitive calculations. These variables are the easiest for the computer to get to. Next are A through V. Of subscripted variables, A(23) through A(100) are the best, but slower than A through V. A(1) through A(22) are the hardest to locate. Although my testing was not extensive, W through Z seem to be about 20% faster than A through V, and about 75% faster than A(1) through A(22).

In selecting options, the following form can be useful.

```
100: INPUT "RATE? ";Z$: GO TO 200
110: INPUT "TIME? ";Z$: GO TO 300
120: INPUT "DISTANCE? ";Z$: GO TO 400
130: GO TO 100
```

At line 100, if any character is entered, "GO TO 100" will execute. If only ENTER is pressed, the balance of the line is ignored; execution will continue to line 110. Line 130 causes a return if no item was entered.

Sometimes it's convenient to use the following form. Two values are expected and the program will branch to the section for whichever item is zero.

```
100: R=0: INPUT "RATE? ";R
110: T=0: INPUT "TIME? ";T
120: D=0: INPUT "DISTANCE? ";D
130: IF (R>0)+(T>0)+(D>0)=2 THEN 150
140: PRINT "TRY AGAIN": GO TO 100
150: IF R=0 THEN 200
160: IF T=0 THEN 300
```

In lines 100-120, a number can be entered or, if only ENTER is pressed, zero will remain assigned. Line 130 checks to see that two positive values were entered. Note that (R>0) will have the value one, if true. If entry is valid, the item left as zero will cause a branch to occur to the appropriate section. If R and T are both non-zero, D is zero. Computation related to D can begin immediately following line 160.

On branching, "GO TO A$(J)" can be executed, where A$(J) is a label. (For example, if line 100 begins with "K" and A$(J) = "K", GO TO A$(J) will cause a branch to line 100.) However, branching to a line number seems to be 30% to 40% faster. Use GO TO N, where N is assigned by the program. The same is true of GO SUBs; line numbers are reached faster than labels.

Loops are time consuming, but FOR-NEXT loops execute almost twice as fast as a counter and test. It's bad coding to exit a FOR-NEXT loop prior to completion of the count, but I've been know to violate this rule. The computer doesn't seem to mind. I also try to locate my most heavily used loops at the top of the program. It seems to speed up execution.

Since line numbers take two bytes, multiple statements per line save space. Instructions are saved as 2-byte codes. Therefore, it's possible to place what appears to be more than 80 characters on a line. PRINT 1: PRINT 2: PRINT 3 etc., appears to be eight bytes per statement. Actually each stores as four bytes, including the colon. Spaces are ignored. Therefore you can load 20 statements on one line—a line that appears to be much longer than the 80-byte buffer. However, use this notion sparingly. It's easy to get things so muddled up you can't read later what's written today.

The following

```
10: INPUT "R? ";R
20: INPUT "S? ";S
30: INPUT "T? ";T
```

can be written effectively as

```
10: INPUT "R? ";R,"S? ";S,"T? ";T
```

When run, each input statement will display on a separate line.

3*A*B can be coded as 3AB. 3*(A+B) requires the multiplication sign. However, (A+B)*C can be coded as (A+B)C. Closing quotes and parentheses can be omitted if they're the last character of the line.

Some forms of tests save time and space. Try IF K for IF K>0 and IF -K for IF K<0. Also try K=K+(L<1) for IF L<1 LET K=K+1. This works because when L<1 is true, the value of (L<1) is one.

If you're using the computer as a calculator, and have typed in an extended formula and pressed ENTER, the formula disappears and the result is displayed to the right. Press the back-arrow to restore the formula. This is particularly useful when the result is clearly incorrect or only a minor change is needed. After pressing the back-arrow, you can edit and press ENTER again.

The purpose of the PRINT USING statement on this computer is puzzling. It truncates rather than rounding off. There are no fancy features, such as a floating dollar sign. Yet there are all the usual risks of a run-time error. Therefore, I don't use it. I use a roundoff routine and output results unformatted.

```
800: Z=INT(Z*X+.5)/X: RETURN
```

If only hundredths are needed throughout a program, change X in the above to 100. This will save assigning X before executing a GO SUB.

In working with interest formulas, I'm getting more error than I'd like. $1.001^{1000}$ is 1.105165393. Straight multiplication with the same computer gives 1.105165374. Exponentiation, in this case, has held accuracy to only eight places. On any computer, there is some loss of accuracy when exponentiation occurs. However, the above error seems large. Computation of interest due on a $50,000 loan, accumulated over time, could easily be more than a dollar in error.

In summing the terms of $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots$, the computer rounds off after computing and adding the 31st term, giving an incorrect sum of 1. There must be an easy solution.

$M^3$ or any power, won't go if M<0. There ought to be a trick way to handle this. I don't see anything better than holding the sign of M, computing with a positive M, then reattaching + or −, depending whether N is even or odd.

Here's one that took me more time than I'd care to admit. $Z = INT(27^{(1/3)})$ gives 2, which is nonsense. But $Z = {}^{(1/3)}$: Z = INT(Z) gives 3. I haven't a clue why there's a difference in these two forms.

### Program for tax season

It's time to gather notes on those deductions. One big item can be the interest paid on your home mortgage. With a pocket computer, you no longer need a printed amortization

table and you don't have to wait for the loan company to tell you how much you paid.

In the first segment of the accompanying program, the interest for a period is computed by finding the balance due at the beginning of the year and subtracting the balance due at the end of the year. This difference is the amount of principal paid in the year. When this amount is subtracted from the total payments made, the result is the interest paid. In the second segment, interest is computed by accumulating the interest for each payment. Because of the error mentioned above in exponentiation, there can be a difference in the results from the two methods.

Both segments of the program use the same routine for finding the period numbers to be considered. For example, a loan taken out in 1973 can be entered as year 1. Then, if the current year is 1981, enter 9. 1981 − 1973 = 9 − 1 = 8. It's the difference in the years that's used in computation. If you know what these periods are for your loan, a much simpler routine can be used. Provide for entry of the first period and the number of periods needed.

The second method asks for the initial balance. If the first method is discarded, the code used to find the initial balance can be held (lines 30-90). However, if the initial balance will always be known, the second method can stand alone with direct entry of the initial balance.

Note that Y, the number of periods per year, is set to 12 (months). You can change this as needed in line 10. Also note that there's no need for both segments. They're included here so you can choose what you like. If you've one of the new variable rate loans, use the second segment and run the program separately for each period for which the interest rate is constant.

With the following changes, the program will run on the Casio FX-702P.

| Change | To |
|---|---|
| PRINT | PRT |
| INPUT | INP |
| ; | , (in INP) |
| ^ | ↑ |

Also use SET 2, instead of GO SUB 900 and the subroutine at line 900. Omit the initial colon in each line.□

**Program listing**

```
 5: PRINT "INTEREST PAID"

    - Set number of periods per year.
      Change to suit.
10: Y=12

    @                 @
    @@@   METHOD #1   @@@
    @                 @

    - Get original balance, amount
      borrowed.
15: INPUT "ORI AMT? $";A

20: INPUT "PYMT? $";P

    - Convert annual rate to rate for
      a period as a decimal.
25: INPUT "RATE AS %? ";R: R=R/Y/100

    - Find term of loan, total number
      of periods.
```

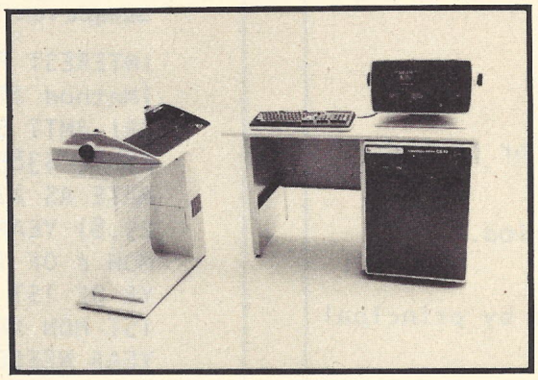
```
 30: N=-LOG(1-R*A/P)/LOG(1+R)
     - Convert to years and display.
 35: Z=N/Y: GO SUB 900
 40: PRINT Z;" YEARS"
     - Get period of interest.  Begin
       with month and year loan taken.
       Years can be relative.  (e.g.
       For 1973 and 1981, use 1 and 9.)
 50: INPUT "MON # OF 1ST PYMT? ";X
 55: INPUT "YR OF 1ST PYMT? ";Z
     - Compute base period number.
 60: C=Z*Y+X
     - Get first period needed.
 65: INPUT "1ST MON NEEDED? ";X
 70: INPUT "YEAR NEEDED? ";Z
     - Convert to first period number.
 75: D=Z*Y+X-C
     - Get number of periods needed.
 80: INPUT "# OF PERIODS? ";E
     - Find balance due, first period.
 85: Z=D: GO SUB 800: GO SUB 900
     - Hold first balance and display.
 90: W=Z: PRINT "INIT BAL=$";W
     - Find ending balance.
 95: Z=D+E: GO SUB 800: GO SUB 900
100: PRINT "FINAL BAL=$";Z
     - Compute total of payments.
       Find principal paid, difference
       between two balances.
105: X=P*E: Z=X-(W+Z): GO SUB 900
110: PRINT "INT PAID=$";Z

     @             @
     @@@ METHOD #2 @@@
     @             @

     - Get loan balance, beginning
       of period.
200: INPUT "INIT AMT? $";A
     - Get payment.  Use ENTER only if
       entered above.
205: INPUT "PYMT? $";A
     - Get rate and convert for a
       period as a decimal.  Use ENTER
       only, if entered above.
210: INPUT "RATE AS %? ";R: R=R/Y/100
     - Get number of periods needed.
```

```
      Use ENTER only, if entered
      above.
215: INPUT "# OF PERIODS? ";E

     - Compute and accumulate interest
       paid each period.
220: Z=0

225: FOR V=1 TO E

     - Compute interest for period.
230: W=A*R

     - Accumulate for period.
235: Z=Z+W

     - Reduce balance due by principal
       paid.
240: A=A-P+W

245: NEXT V

     - Roundoff and output result.
250: GO SUB 900: PRINT "INT PAID=$";Z

255: Z=A: GO SUB 900

260: PRINT "BAL=$";Z

265: GO TO 999

     - Subroutine: Find balance due.
800: Z=(P/R*(1-(1+R)Λ(Z-N)): RETURN

     - Subroutine: Round to hundredths
900: Z=INT(100*Z+.5)/100: RETURN

999: END
```

**Sample run**

```
INTEREST PAID
(Method #1)
ORI AMT? $50000
PYMT? $385
RATE AS %? 8.5
29.81 YEARS
MON # OF 1ST PYMT? 6
YR OF 1ST PYMT? 1973 (or 1)
1ST MON NEEDED? 1
YEAR NEEDED? 1981 (or 9)
# OF PERIODS? 12
INIT BAL=$46078.57
FINAL BAL=$45347.19
INT PAID=$3888.62
(Method #2)
INIT AMT? $46078.57
PYMT? $385
RATE AS %? 8.5
# OF PERIODS? 12
INT PAID=$3888.62
BAL=$45347.19
```

# Data General CS/10



## Entry-level Model in a Minicomputer Family

| | C-3 Accounts Receivable Time | Current Price |
|---|---|---|
| Data General CS/10 | 2:40.3 | $13,400*** |
| Alpha Micro AM-1011 | 3:25.3 | $15,605 |
| Ohio Scientific C3-A | 15:49.3 | $10,940 |
| Digital Microsystems DSC-2 | 3:28.8 | $ 9,015 |
| Apple II Plus | 6:17.4 | $ 4,330 |
| Radio Shack TRS-80 Model II | 3:36.8** | $ 7,609 |
| Pertec PC 2000 | 6:04.3 | $12,470 |
| DECstation 78 | 5:04.8* | $10,495 |
| Vector Graphic System B | 5:56.5 | $ 8,995 |
| Texas Instruments Model 771 | 3:38.1 | $12,100 |
| North Star Horizon | 1:57.7 | $ 6,911 |
| Cromemco System Two | 2:48.0 | $ 9,275 |
| Wang 2200SVP | | |
| Altos ACS 8000-15 | | |
| ACS 8000-6 | | |
| NEC Astra 205 | *to be covered in future issues* | |
| SD Systems SD200 | | |
| IBM 5120 | | |

*Includes both compile and run time
**Program optimized by Radio Shack ran in 2:59.3
***Tested under hard disk, raising price to $15,300

by Hillel Segal

The CS/10 computer from Data General (Westboro, MA) is especially notable because it is the smallest model in a rather large family, the commercial systems (CS) line. Other models stretch up to the size of large minicomputers. Software transportability between members of this family allows users to have a uniform set of programs running on computers of various sizes. One principal benefit of the approach is that as a company outgrows its computer, the step upward is easier to make.

Like other CS systems, the CS/10 is programmed in interactive Cobol, a standard language available on all business computers made by Data General. The compatibility of the language throughout the family of systems makes possible the transportability feature.

While the CS/10 did well when running the business-oriented application for which it was designed, the

semi-compiled Cobol isn't the greatest for scientific number-crunching. Benchmark testing conducted for the Association of Computer Users (ACU) revealed a system strong in file-handling and storage tasks, but weaker in the type of math functions that scientific applications generally require. Of course, Cobol isn't used much in science anyway.

The tests were conducted for ACU by the Business Research Division of the University of Colorado, with standard programs being used to compare the time it takes to perform similar tasks on different computers.

In this case, the programs had to be translated into Cobol for the CS/10. (Business Basic is now available for the system, but was not at the time the tests were run.) Data General personnel performed the translation, and their work was checked for accuracy by our consultants before the tests were run.

The CS/10 can be purchased with floppy or hard disks, but the company did not want the floppies used for the benchmark testing. As a result, on those tests that use disk access (including the accounts receivable test), the hard disk was used instead.

For this reason, comparisons of the benchmark times between this system and others in Series 1 of our tests should be done with caution: the other systems were tested with floppies. In some cases, hard disks were available for those systems (or are now) and their times would certainly improve if those were used.

Looking at the performance on the accounts receivable test, we note that the time of 2 minutes, 40.3 seconds is better than nearly al the times of the other systems (not unexpected, since they're using floppies) but is still beaten by one—the North Star Horizon.

The CS/10 is available in two models: the C1, with 64,000 characters of memory, and the C3, with 128,000 characters. We tested a version of the C1 that was equipped with a 1.2 million character floppy disk drive and a 12.5 million character hard disk. The basic unit, including display console, MicroNova processor and disks costs $12,850. The Dasher TP1 printer, a 60 cps dot matrix printer, adds $2,450.

Storage options for the Model C1 include 12.5 and 25 million character hard disk drives,up to a maximum total capacity of 50 million characters.

Using interactive Cobol, the system can be configured with up to four terminals, including the master control. With Business Basic, up to five terminals may be used.

The keyboard has programmable special function keys, and these can be designated for operator commands during use of the programs.

**Software supplied by OEMs**

Software for the CS computers is supplied chiefly by OEMs who market the equipment to end-users. Data General itself does not supply any applications packages.

To facilitate the development of programs by the software houses, the unit comes with a number of sophisticated utilities. Some of these assist with file management, system management and program debugging. A special screen utility is provided for the automatic generation of screen faces for user reference. These screens can then be recalled from within the Cobol program with a single reference.

Other utilities can create a data base system or a report writing facility. These aids help the commercial systems suppliers create applications with a minimum of effort.

Three program editors are offered: a line-oriented interactive Cobol editor, a general-purpose screen editor and a string-oriented editor.

While these applications development products could be used by customers to write their own programs, the marketing approach taken by Data General doesn't really encourage this. Instead, the emphasis is placed on creating and maintaining a strong group of OEMs to identify customer applications, create the software and documentation, and ultimately sell and install the equipment.

The Data General documentation is oriented to meeting the OEMs' requirements more than putting the

***Customers found widespread satisfaction with hardware reliability and service.***

tools in end users' hands. Those who decide to program themselves will still need to depend on the OEM for information and assistance.

When our consultants surveyed Data General customers, they found widespread satisfaction with hardware reliability and service, but less strong support of the OEM efforts to furnish programming and train users of the systems.

Since the CS/10 was a new product, the interviews were conducted with customers who had functionally similar CS/30 systems. The firms contacted included manufacturers and wholesalers, hospitals and clinics, CPAs and several other businesses. Most of the applications mentioned by users were in the accounting area: payables, receivables, payroll, general ledger and such. Some invoicing and data base management were also noted.

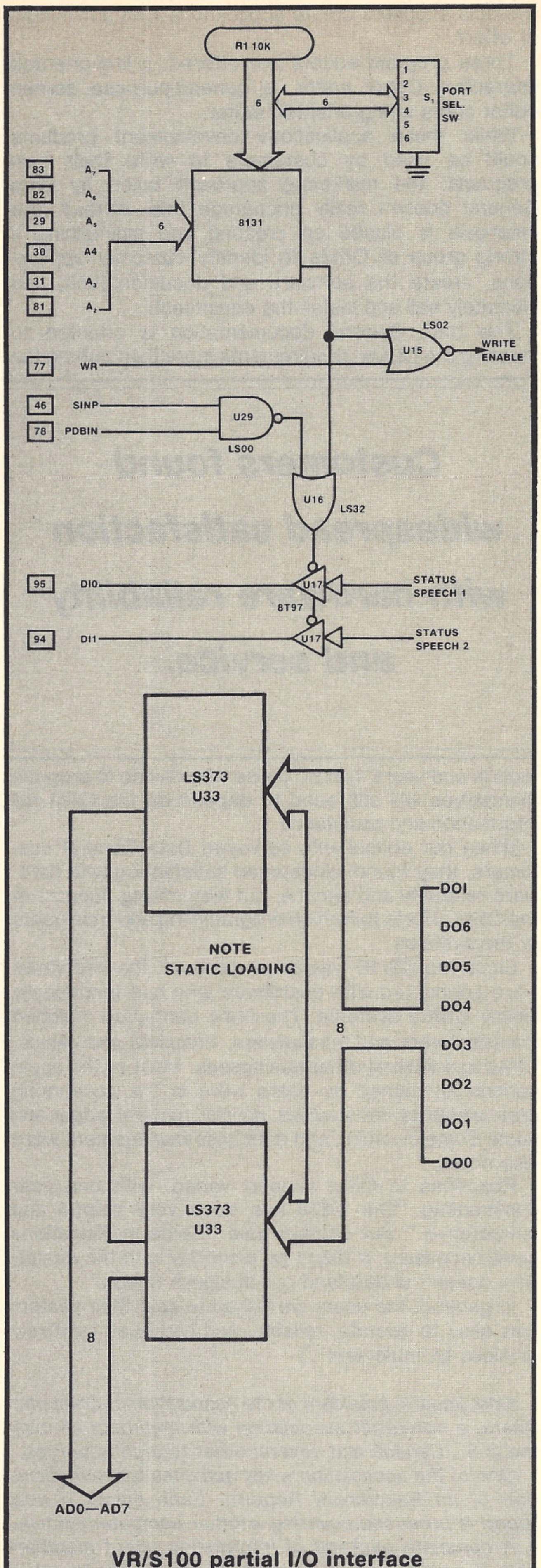
Reactions to OEM support varied, with one user commenting "Our OEM has been very helpful and cooperative." But another said "Some modifications were necessary. It didn't go smoothly with the dealer, who doesn't understand our business needs."

In general, the users we talked to said their system was easy to operate, reliable, and had been relatively painless to implement. □

*Hillel Segal is president of the Association of Computer Users, a non-profit association with members all over the U.S., Canada and several other foreign countries.*

*One of the association's key activities is the publication of its Benchmark Reports. Each month a new report is produced covering another computer system.*

*A complete package of information about membership is available from ACU, P.O. Box 9003, Boulder, CO 80301.*



VR/S100 partial I/O interface

## Hardware Evaluation

# Speech Technology's VR/S100 Speech Generator

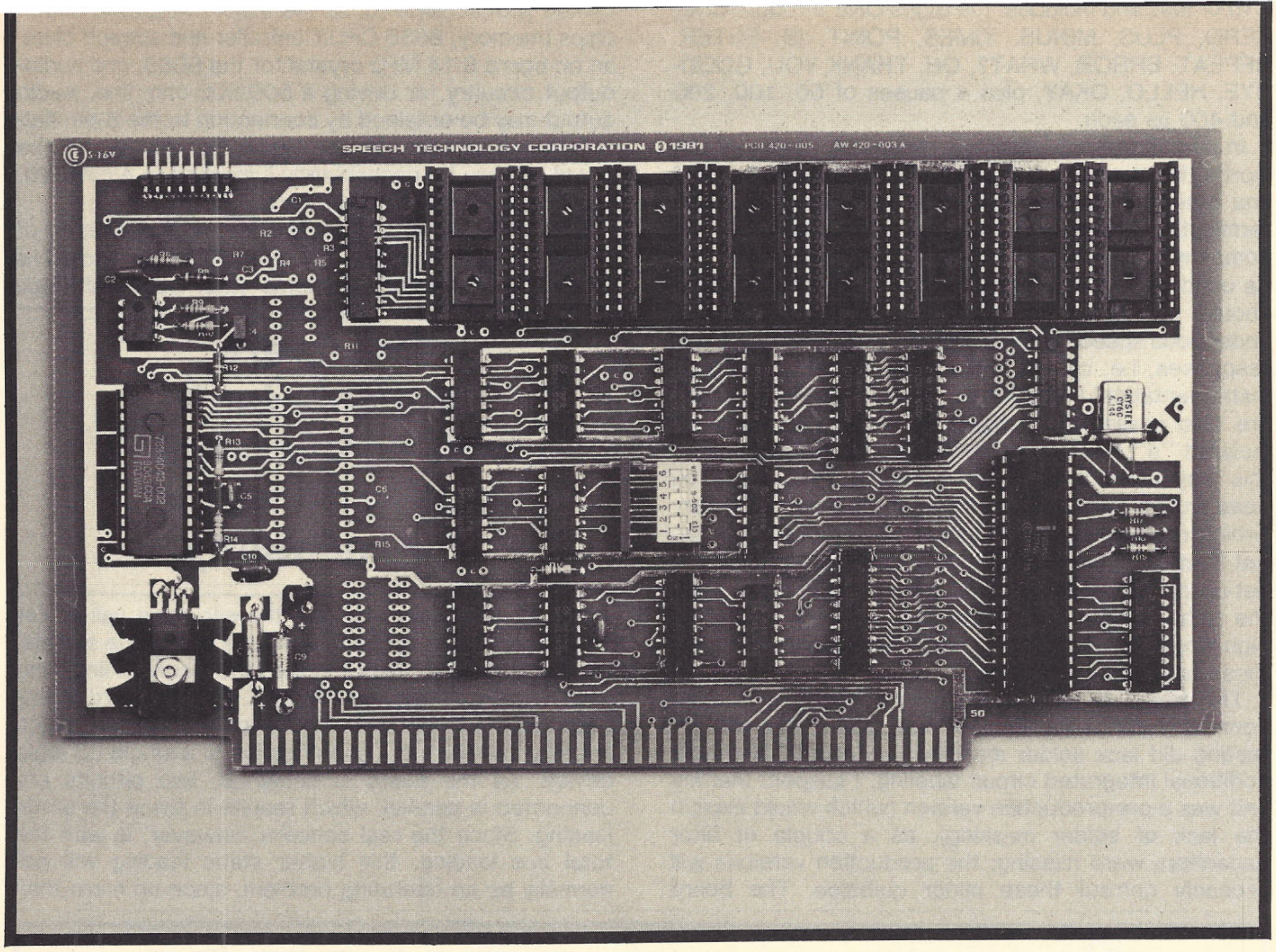
## Device with vocal adherents

by Roger H. Edelson

Probably the most active areas in the computer peripheral field today are graphics (both video display and hard copy) and interactive synthetic-speech technology. In the synthetic-speech field, the computer either listens or talks. Listening and understanding are the difficult problems, with no clear-cut solutions as yet. The talking (or vocal feedback) problem has been solved reasonably effectively, with three different technologies vying for marketplace dominance—Linear Predictive Coding (LPC), Waveform Analysis, and Phoneme Coding.

The LPC technique, probably most familiar as the voice behind Texas Instruments' Speak-N-Spell, uses a vocal track model to convert digital data to speech sounds. One advantage of this technology is that the same stored speech information can take on different vocal characteristics by varying the vocal-tract model parameters.

National Semiconductor's recently-announced Digitalker is one of the most well-known examples of this




speech-synthesis technique. In this technology, a mathematical formula (usually company proprietary) digitizes a recorded word. The formula is used to simplify the normally complex speech waveform, thereby significantly reducing the amount of storage required to hold each word. This technique results in some of the most natural-sounding speech, but usually requires the most memory. Phoneme coding requires the least memory space, but this technology does not usually produce human-like speech, particularly at present. These descriptions are generalizations, of course, and each technology has its dedicated coterie of highly vocal adherents.

The VR/S100 board from Speech Technology Corp. (Santa Monica, CA) generates speech by using the LPC technique, which combines a 12-pole vocal-tract model with on-board vocabulary storage of up to 250 words. The designer of the board has been in the speech-synthesis field almost since its inception, and developed one of the first speech-synthesis boards for the S-100 bus over five years ago. Unfortunately, the state-of-the-art at that time predicated an analog solution to the vocal-tract filter model, along with significantly lower density chips used for vocabulary storage, and the device was simply not viable in the marketplace.

This new offering, however, uses a single integrated circuit manufactured by General Instruments (but designed and developed by Speech Technology) to model the vocal-tract; speech storage is accomplished using either 16K or 32K PROMS (or EPROMS). With this technique, 12 to 20 words may be stored in a 2716 type device; the 2732 chips can hold twice as much vocabulary. The actual card may be obtained as either a single speech chip model (VR/S100A), or configured with two speech chips (the —B) operated by the on-board 8085 processor. The single speech chip model is priced at $275 and the dual model runs an additional $50; both prices are for models without vocabulary memory.

Pre-programmed speech memory is also available from the company at $30 for the 2716, or $60 for the 2732 devices, which works out to about $4 per word. A 32K-first-chip vocabulary of 24 words is available for

$10 or less and includes: the digits ONE through NINE, ZERO, PLUS, MINUS, TIMES, POINT, IS, ENTER, REPEAT, ERROR, WHAT?, OH, THANK YOU, GOOD-BYE, HELLO, OKAY, plus 4 pauses of 50, 100, 200 and 400 $\mu$s each.

In addition to the standard vocabulary, many of the words (the numbers 0 thru 19, 20 thru 90, 100, 1000 and others) are available in both terminating and non-terminating inflections. For general applications, the company recommends that the terminating inflection be used. If possible, however, both sets of intonation should be stored to provide more natural, easily-understood speech when the board is used for numerical responses, i.e. clocks, calculators and scientific/test instrumentation. Plural forms of commonly-used words are also available; for space-limited applications, an isolated "s" can also be provided, but in some cases this may produce unnatural-sounding speech. If you need words that aren't available in the standard library (which now contains more than 300 words), you can get them at a cost of $200 per second, with a minimum set-up charge of 5 seconds; this is designed to keep the ribbon-clerks out of the game. (There is really a high single time recording charge or speaker to record these non-standard words.)

The board is nicely built with a gold-plated edge connector for reliability, but the one I received for testing did lack solder masking and could have used additional integrated circuit labeling. I suspect that my unit was a pre-production version (which would explain the lack of solder masking), as a couple of filter capacitors were missing; the production versions will probably correct these minor quibbles. The board comes with sockets for all the major integrated circuit chips (memory, 8085 CPU/Controller and speech chip), an on-board 6.14 MHz crystal for the 8085, and audio-output circuitry for driving a 500/600-ohm line. Audio output may be obtained by connection to the 8-pin flat-cable plug located on the upper-left portion of the board, or may be conveniently jumpered to 4 pins (20, 21, 27, or 28) of the S-100 bus.

The VR/S100 was designed before the release of the IEEE- 696 Standard for the S100 Bus, and while there are no timing problems (the worst interface incompatabilities to resolve), the allowable values for static loading are exceeded on nine of the bus signals, the eight Data Out lines and the SOUT control line. The problem occurs because the IEEE-696 Standard allows S100 bus receivers to sink no more than 0.5 mA, which is just about the input specification of a single LS logic device. As the board is designed, two circuits are connected in parallel, which results in twice the static loading. Since the real concern, however, is with the total bus loading, this higher static loading will not normally be an operating problem, since no more than

**The board is nicely built with a gold-plated edge connector for reliability**




CIRCLE INQUIRY NO. 6

one of these boards would be used in the system. In the case of a single speech-chip board, the LS 373 data storage circuit for the second chip is not present on the board. Therefore, in this case, the data line loading does not exceed the IEEE specifications. It was indicated by company representatives that the board will soon undergo a mild production revision, and buffers will probably be included in this later version. Only in those rare cases where the bus is fully loaded would it be worthwhile to wait until the new design is released.

The board is port-controlled, with a six-bit DIP switch used to set up the six most significant bits of the port address (A2 thru A7). Information is entered into the board (or its 128 byte buffer) by outputting a byte at the selected base port address plus 1 (i.e. if a port address of 20H is selected, data is outputted to port address 21H). The board status (BUSY/NOT BUSY) is obtained by checking BIT 0 of the byte located at base port address (PAb) or PAb + 1, + 2 or + 3. In the case of the two speech-chip board (—B), the status of the second buffer is obtained by checking BIT 1 of the same location. The other bits of this particular byte aren't even available on the data input lines. A circuit diagram of a portion of the board I/O is presented in the accompanying figure.

That's about all there is to using the board. One additional feature has been provided to allow on-board storage of a string of words before beginning to output speech. In this case, the first byte sent to the board should be a null byte (0H). The following bytes (which request the words to be outputted) will then be stored in the on-board RAM, up to a maximum of 128 bytes. If more storage is attempted than is available in the on-board RAM, the buffer full bit will be asserted, and the board will refuse to accept any more data. Speech output is initiated anytime a second null byte (0H) is sent to the board. You need not wait until the buffer is full, of course; the speech string may be any desired length, from one byte up to the RAM maximum.

### Small sound problem corrected

The sound output from the board is intelligible and natural-sounding. The model I heard first had a somewhat objectionable ringing sound when outputting certain words, notably SIX and THREE. At the time the company president John Stork noted that he couldn't detect the ringing, but he later verified its existence with an oscilloscope. To correct this problem, a small change was made in the parameters of the vocal-tract model to reduce the Q of one of the filter poles, thereby eliminating the transient oscillations on a few words.

One nice feature of the LPC synthesis technique is that it is possible to modify the vocal tract model by changing the chip parameters under software control. This allows the user to change the pitch and tempo of the speech output. The only control missing is one that varies the speech volume, which would a valuable feature when highlighting a particular word. The company representatives indicated that this feature may possibly be implemented on the new revision.

Speech synthesis, both input and output, will probably be the wave of the future in computer-human communication. With this board, it is possible to add a large vocabulary of very intelligible speech output to a computer for a modest cost. □

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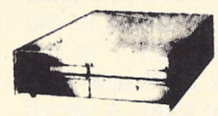

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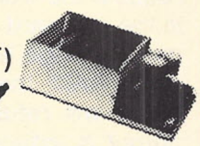

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CIRCLE INQUIRY NO. 97

# Articles Wanted...

INTERFACE AGE is seeking articles on computer communications and networking for the July issue. Data communications and public data bases are topics of interest. Comparative evaluations of data communications hardware and software will also be considered. Articles intended for this issue should be received no later than March 1 for consideration.

Other topics needed during 1982 include: business hardware and software, computer art and graphics, computer languages, medical and educational applications, word processing, peripherals and interfacing products, home applications, tutorials and utility programs. Special emphasis is placed on business systems and applications.

Program listings should be no more than 60 characters wide, with no wrap-around lines. Unlined paper and a new ribbon should be used. Sample runs should also be included. In the article, variables should be described. The system utilized in composing the program should be detailed — operating systems, language type and version, and any necessary peripherals.

The payment rate ranges from $35-80 per published page. Submissions should include an abstract and outline.

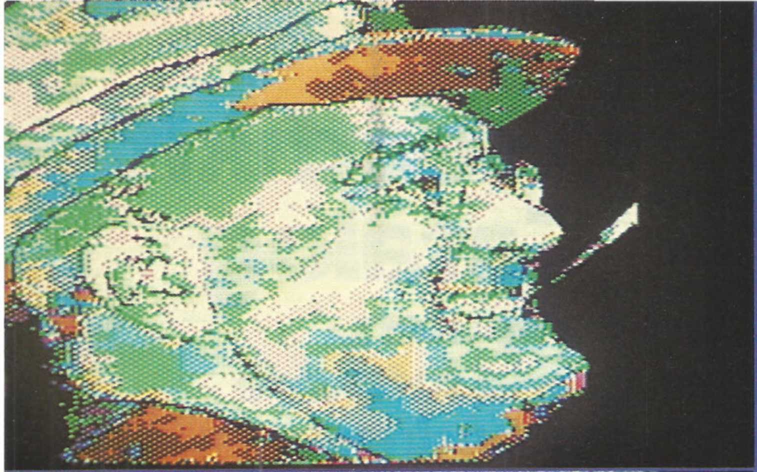
Manuscripts should be typed or printed out double-spaced with one-inch margins. Minimum length is four pages, unless programs are included. Photos should be numbered and have a brief description attached to each. Tables, listings, etc. should be on separate pages and each should have a caption. Authors are requested to submit a statement of their background and expertise.

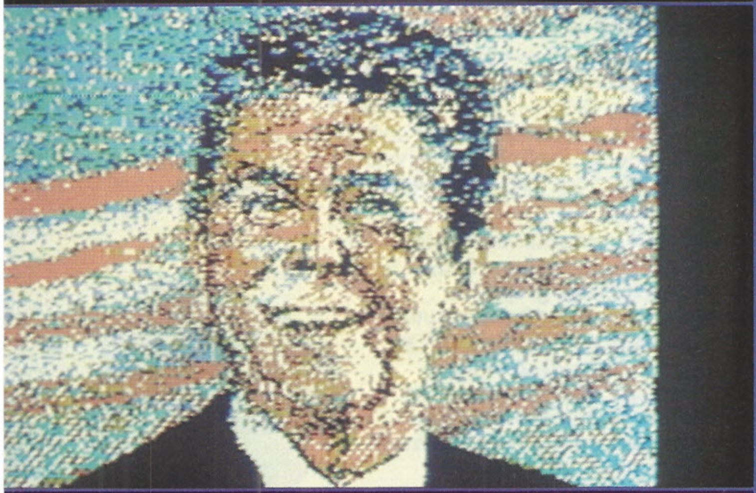
The publisher assumes no responsibility for artwork, photos or manuscripts. No acknowledgement is made unless the submission is accompanied by a stamped return envelope large enough to return the article, in case it doesn't suit our present needs. A minimum of six weeks should be allowed for response; it is requested that authors do not phone for information about submissions.

The submissions should be addressed to: Editorial Dept., Interface Age, 16704 Marquardt Ave., Cerritos, CA 90701.

# Graphics Capabilities for the Small Business

by Terry Benson





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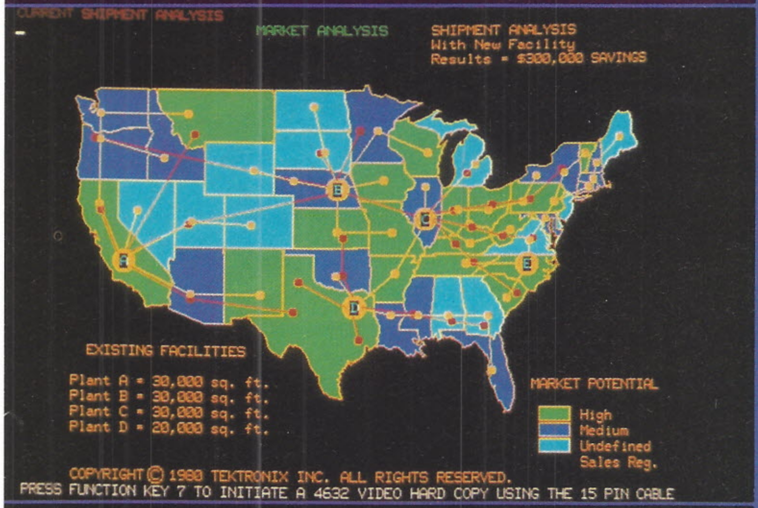
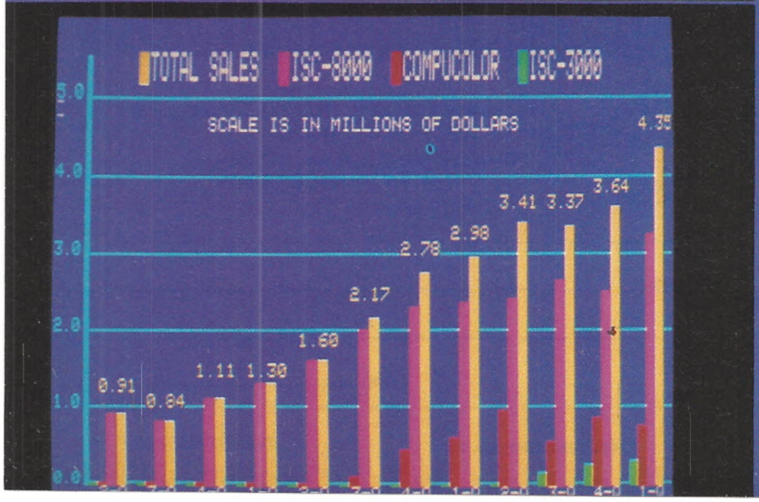



Graphics capability in a small business computer can enhance the communication of data and can be used to facilitate operator responses. The use of such information can increase productivity and provide more effective problem solving. Conceptual representation of facts and visual aids required for evaluating all types of abstract and physical data are enhanced through graphic presentation. The representation of numeric data in graphs and bar charts is frequently the most familiar (if not the only) application example. But there are several other useful applications that demonstrate the economic alternatives available.

The old adage says "A picture is worth a thousand words." In actuality, a graph might be worth something like 10,000 or 100,000 words, and certainly there are many graphic examples that can't be described effectively in words (e.g. a 3-D image). Business graphics and related artwork can effectively reduce the number of words required to describe a situation, and even make the information more interesting to review.

In a study prepared by IBM, graphics have been grouped into the following six major categories representing applications that might be implemented in a small business.

*Basic data presentation* includes graphs and charts that can be used to represent statistical information or other numeric data. For example, a sales graph displaying the past and projected performance of the sales effort can be displayed or easily modified to include new forecasts as they become available. Full color graphs and charts can be produced on a color CRT (or TV screen), then photographed for sales presentations and seminars.

*Topological definitions* include program flow charts, chemical or physical processes, organization charts, electronic schematics and other similar line drawings. Many of the software packages available for business computers support this category of computer graphics since these are

perhaps some of the more useful graphic applications for the small business.

*Geometric data entry and exit* allow the user to draw structural, mechanical and architectural designs. These applications frequently require the use of higher resolution displays and, consequently, more sophisticated graphics systems. There are, however, some applications in this category that can be adapted to the standard CRT or TV (color, if required). An example might be in the generation of maps.

*Three-dimensional geometry and geometic design* probably represent the most challenging segment of computer graphics. Not only does an object have to be represented in 3-D, but it usually will have to be rotated to allow observation of different views of an object. This is required in applications that display structures, such as a bridge; curved surfaces; or even small mechanical parts. Usually applications in this category will require a complete graphics system to support the high-speed display requirements.

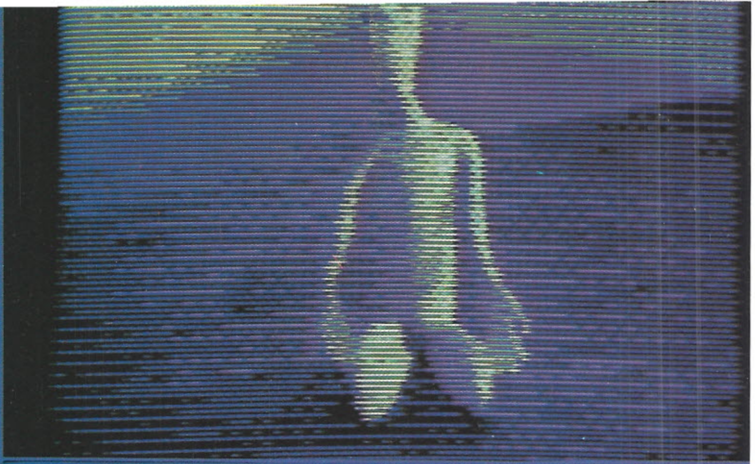
*Monitoring and control graphics* can improve the display of data recording and the subsequent analysis. This could be useful in medical applications where a patient monitoring system provides its output to a graphic display. Other applications in this category include those that are providing real time information about the performance of a manufacturing operation, chemical process, or a distribution system such as in power control systems for energy management.

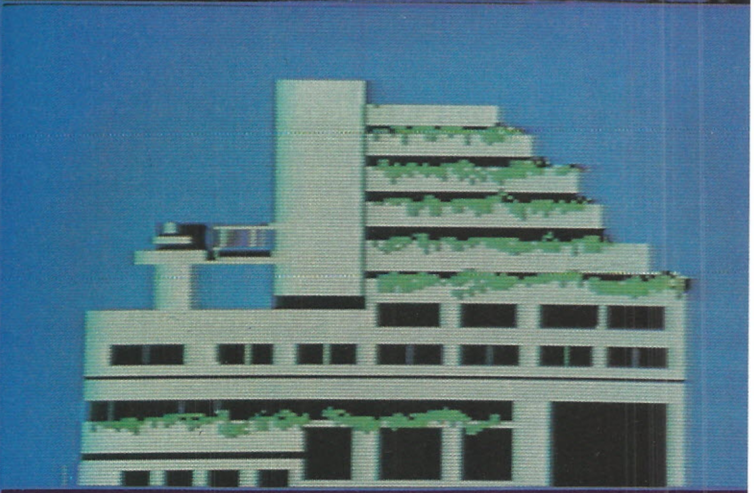
*Mixed graphics* is the type frequently used to represent textual material in addition to pictures. News broadcasts using the teletext magazine format are good examples of this. The graphics enhance the readability of the material and highlight certain information. This same technique can be used to prepare technical documentation, especially for the generation of material to be used in group discussions.

Graphic art and even color animation can be created on many of the small business computers. The use of animation often demonstrates processing operations, product assembly steps and information routing. Another frequent use of color graphics and animation involves the playing of computer games.

The use of computers in the support of design and manufacturing, frequently referred to as CAD/CAM, has been proliferating in the past few years to produce more capability at lower cost than ever before. The problem in supporting such applications with the standard terminal is the lack of resolution. High performance graphics systems are used in these applications because they offer superior resolution, thereby providing sharper images. A particularly noticeable problem area is in the drawing of diagonal or curved lines.

The use of graphic displays in aircraft simulators has improved pilot performance and reduced the cost required for learning to fly private, commercial and military aircraft. The same techniques can be applied to the training of operators on less sophisticated equipment in the office or manufacturing environment. In order to





***Photos provided by Apple Computer***

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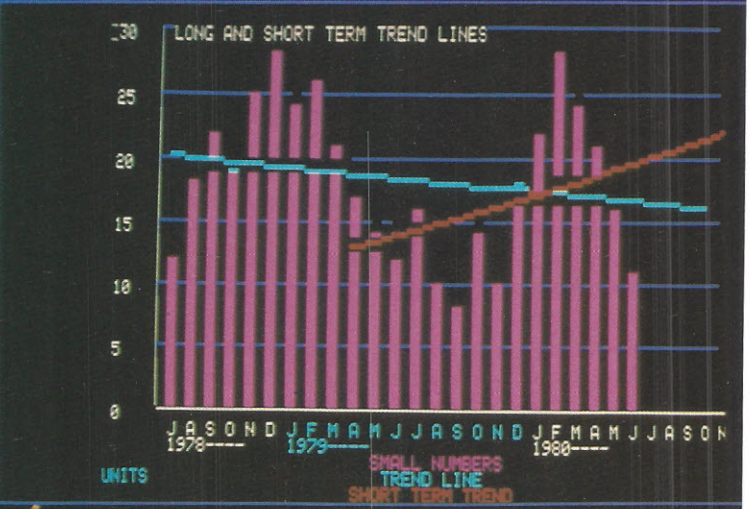
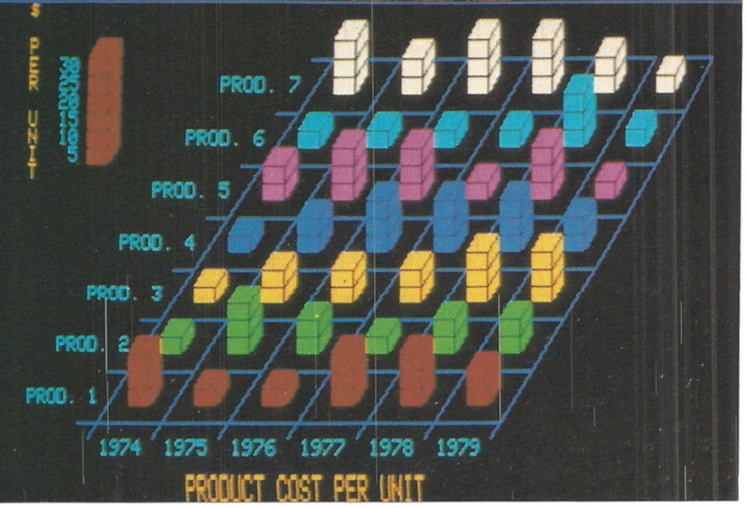


use the graphics capability in these interactive applications, the type of operator input becomes very important.

The most common human input to the computer is the keyboard. While many of the graphics applications require no more than the conventional keyboard input, interactive graphics will generally require something more convenient for moving lines or dots around on the screen. This is particularly true when the normal human response to a situation would involve more than just typing the character. The movement of a joystick gives more *feel* to the system. Similarly, the use of light pens, touch panels and tablet digitizers can simplify the interaction with the computer.

In order to accommodate all types of requirements, graphics terminals and software routines come in various styles and packages. The true graphics terminal will typically have a much higher resolution than that found with the most popular CRT monitors used with small computer systems. In particular, the standard TV used with some systems can provide no better resolution than the one in 525 scan lines used by the TV broadcast industry in the U.S.A. The major problem, however, is the limited bandwidth of conventional TVs—not just the number of raster lines. And worse, those computer systems with a built-in CRT typically allow a resolution of 1 in 240 to 275 unless high resolution graphics are made available. Some of the less powerful systems even limit the graphics capability to block characters, such as you might implement with reverse or inverse video.

The use of eye-catching color in graphic displays provides an additional attraction and extends the human awareness. Although black and white can effectively be used, color can enhance particular conditions or features of an application. For instance, a computer may be monitoring a particular production flow and some out-of-tolerance condition is detected, such as volume too low due to a damaged machine. The condition can be identified with various colors to highlight the condition to the operator. The same holds true in the simple graphic representations of static events, such as a sales chart or territorial map.

As better resolution is required, it may be necessary to invest in a more sophisticated terminal that can produce more detailed pictures. In particular, if drawings are going to be generated by means of the computer, the type of drawing will dictate the quality of the terminal. For computer aided design (CAD), the requirement to generate lines and line drawings will require a higher resolution terminal and perhaps even a complete graphics system. Entire graphics systems are sold to support these high performance CAD applications, but costs range from $25,000 to over $100,000. The more capability you need, the more you can expect to pay. One encouraging note is that prices will be reduced in the next few years, as faster and more powerful microprocessors become available.

## Graphics peripherals

The following discussion introduces some available graphics terminals and related products.

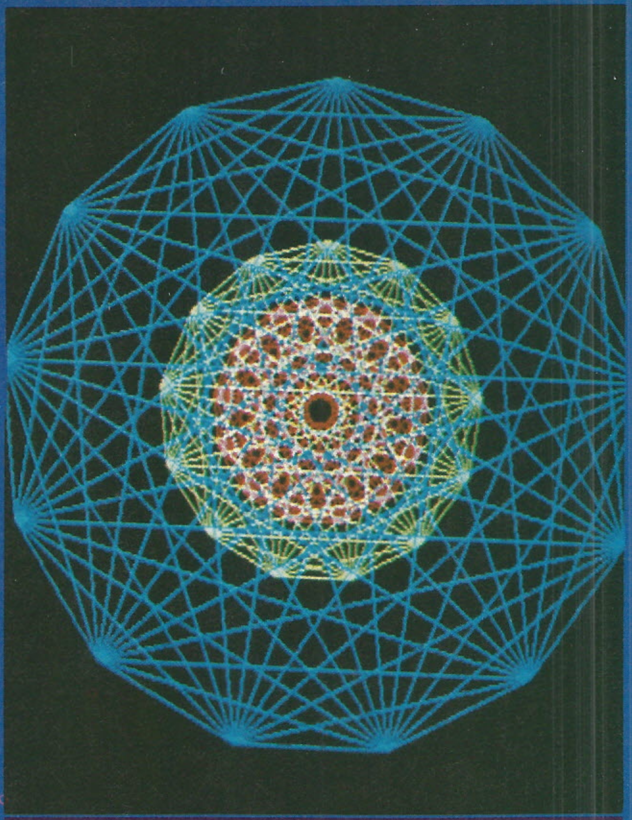


*Photo provided by Aydin Controls, a division of Aydin Corp.*

The intention is to offer low cost solutions to graphics purchase options. While a number of full capability graphics systems are available, we are primarily concerned with terminals, and have attempted to address the less than $10,000 segment of this industry.

Ayden Controls, Fort Washington, PA, produces a variety of color display terminals and display generators that can be attached to virtually any computer system. An RS-232 interface provides convenient communication protocols to any host computer and even offers a local display mode with text and picture editing capabilities. The model 5217 display generator ($2,500 to $5,000) offers a raster scan display with a resolution of 560 by 336, with up to 16 color choices or eight foreground and eight background colors. The display generator supports the use of any RGB monitor, and offers a character format of 48 lines by 80 characters. Operator input can be provided through a keyboard with special function keys or through an optional light pen.

The 5217CT is available in a system configuration as a color display terminal ($5,600 to $15,000). It can be used as a stand alone desktop graphics computer, a stand alone terminal, a graphics add-on, or a complete modular graphics system. The software supported includes CP/M with program languages of Basic, Fortran and Pascal. Optional floppy disks of both 5¼ and 8-in. can be added to the system. A 13 or 19-in. color monitor can be provided with the terminal, which also supports the RS-170 video format.

Barco, available from Electro, Santa Clara, CA,

is a family of color display monitors from Belguim, ranging from 14 in. to 26 in. One model, CD33(HR)-A (at $1,990), provides a high resolution screen with 520 lines interlaced or non-interlaced. Another model, the CM33B (at $2,475), is a 14-in. monitor provided in a compact light-weight case. These displays would provide the perfect companion to any system requiring high resolution color monitors, especially where portable applications are anticipated.

Chromatics, Tucker, GA, offers a broad range of high resolution color graphic computer systems. The CG series desktop version ($5,995 and up) includes interfaces for both RS-232 and parallel applications. Local processing capabilities are provided with a built-in Z-80 microprocessor and a CRT operating system, supporting both Basic and Pascal, may be added. All systems feature a high quality non-interlaced refresh technique that produces brilliant flicker-free screen images. Screen sizes are available in 13, 15 and 19-in. with a 512 by 512 dot resolution. Optional lower priced standard resolution displays are available. The typewriter-style keyboard features 128 keys, including eight programmable function keys in order to program the most often used key-stroke sequences.

Besides the input functions provided through the keyboard, an optional digitizer pad or light pen is available for operator input. An optional RS-170 video input is also available to provide interface to video instruments and cameras. A hard copy interface can also be included to provide direct output to a number of color graphic printers and plotters.

Chromatics also offers a more complete color graphic computer system, the CGC-7900. This 6800-based computer ($14,995 and up) is a complete color graphics work station. The 19-in. CRT provides 1,024 by 768 viewable dot resolution, and up to 256 locations of 24 bits each provide over 16 million possible combinations of color.

Colorgraphic Communications, Atlanta, GA, offers the MVI-7 color graphics CRT terminal, using a Z-80 for local processing capability. RS-232, RS-422, current loop and an auxiliary port are provided for communication with any computer. The basic MVI-7 ($3,500) features a 720 by 288 graphic resolution, two pages of screen memory, and both vertical and horizontal scroll on a high resolution 13-in. display. Split screen capability and four independently addressable screens are standard.

Up to 1,280 programmable symbols can be defined under software control. Input can be provided through the 87-key keyboard, including 24 programmable function keys, or an optional light pen. Color resolution provides seven foreground and seven background colors. The unit can be programmed to emulate six different terminals (VT 100, VT 52, IBM 3101, Hazeltine 1500, Lear Siegler ADM-3 and ADDS) so that immediate hookup in existing configurations can be easily accomplished. The system is available in a desktop configuration or for rack mount installation.

Columbia Data Products, Columbia, MD, produces the model 964/2 Commander computer ($4,995), providing a unique stand alone graphic display microcomputer system. Based on dual Z-80s with 96K of user RAM, this stand-alone terminal can be configured to operate in a complete modular graphics system using one of the four RS-232 ports. Two 5¼-in. floppy drives provide a CP/M operating system with Basic, Pascal and Plot-10 software languages. Dot resolution is 512 by 256 on a 9-in. integral monitor. A built-in RS-170 composite video output channel is also provided.

The 400K bytes of storage can be expanded with external drives. Operator input is provided through the integral keyboard (which includes several function keys), through an optional data tablet, or camera digitizer.

Datamedia, Pennsauken, NJ, has been providing a broad line of general purpose CRT terminals for more than ten years, and more recently has been producing a family of black and white graphics terminals. Earlier this year, the company entered the color graphics market with the introduction of the ColorScan 10 ($3,195). The unit is a complete color graphics terminal with a dot resolution of 240 by 720, or color resolution of eight foreground and eight background colors on a 12-in. display. For character output, the unit supports both 80 and 132-column formats, and is compatible with the VT 100 and VT 52 series of terminals. The unit also provides split screen and regional scrolling and double high or double wide characters. Bi-directional smooth scroll and line scroll are also provided. A standard graphics character set, available in the terminal, provides an effective way for graphic representation of bar charts, histograms and other frequently used business charts.

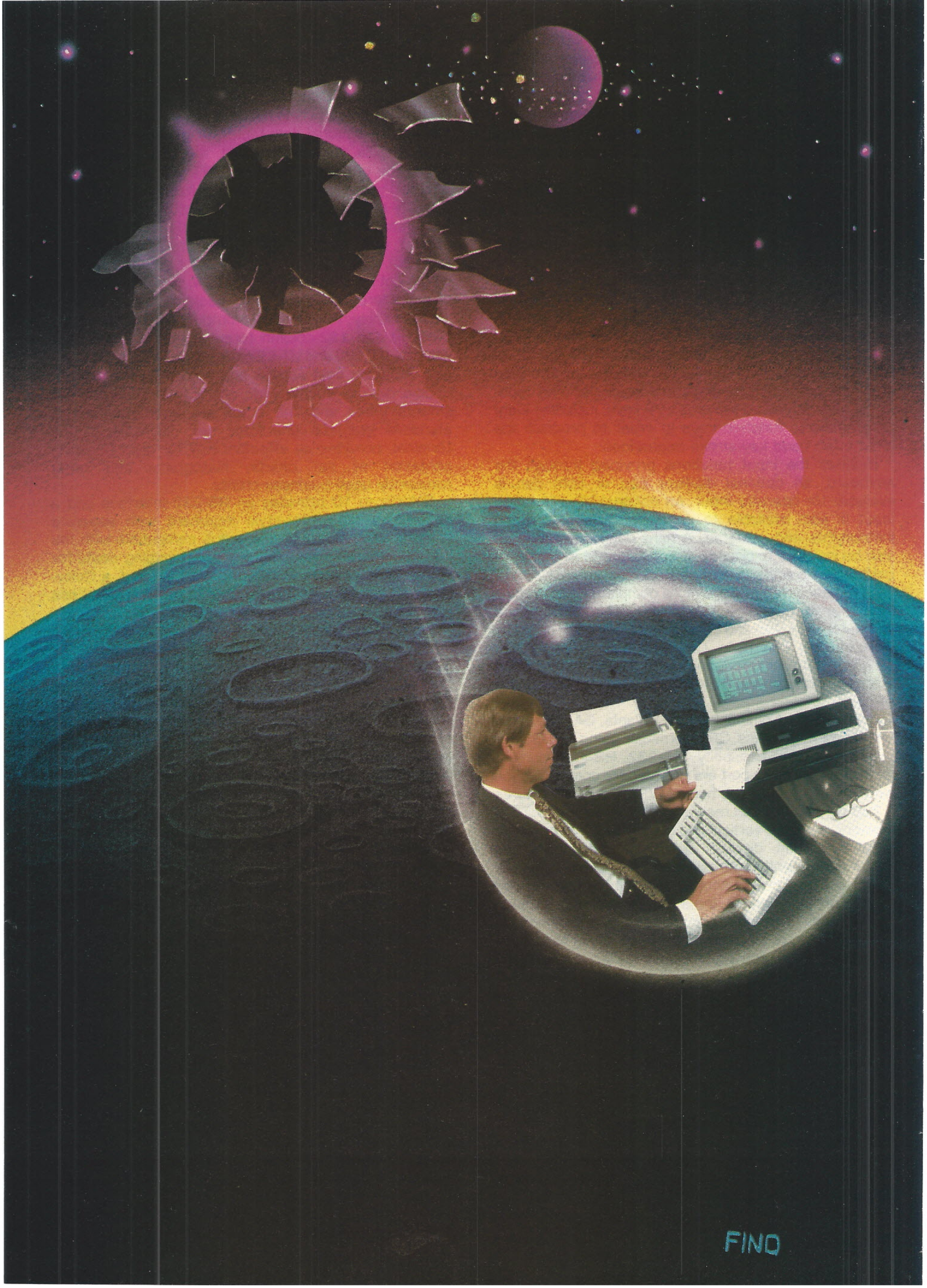
ColorScan 10 provides an RS-232 interface and a detachable typewriter-style keyboard with separate numeric keypad. While this unit is compatible with the VT 100, thereby reducing any programming costs for applications where this DEC product is used, a ColorScan 10 can be used in a number of other applications where business graphics are required.

Digital Graphics Systems, Palo Alto, CA, produces a family of multiboard S-100 frame buffers allowing an S-100-based system to be expanded to support both graphic generation and video imaging functions. The CAT 100 ($1,975) supports a Z-80 or 8080-based system. The CP/M operating system and any of a number of high level languages can be used to communicate with the CAT units. The CAT 100 has an image memory size of 32K bytes and a high resolution format of 484 by 512 pixels. Both low and medium resolution functions are available to provide up to 16 colors per pixel. The color option for the CAT 100 ($150) supports up to 16 colors in the low resolution 242 by 256 pixel mode.

While no monitors are included, the units support either high definition monochrome or RGB color monitors. The video display conforms to the NTSC standard RS-170A. Options include composite color video output and a photographic trigger input, allowing synchronization of a display frame with the shutter of a photographic camera. Input can be provided through a video input port from either live or recorded video signals. A light pen input is available for connection to the CAT. Other inputs that can be provided through the host processor for control of the video images could include joystick, cursor control, digitizing tablet or touch sensitive devices. For higher resolution applications, the CAT family can be provided with up to 256 bytes, thereby providing a very sophisticated graphic imaging system.

Form and Substance, Westlake Village, CA, offers the IM-1 graphics terminal ($3,000), featuring a 15-in. green phosphor screen. Although the system can be

***Continued on page 138***


FINO

# System of the Month: IBM Personal Computer

by Tom Fox

The bombshell was dropped in New York City at 10:30 A.M., August 12, 1980. International Business Machines (IBM, Boca Raton, FL) announced its entry into the personal computing market. Many people were delighted by the news; a lot more were dismayed.

The fledgling microcomputer industry, pretty much left to its own devices for nearly five years, was too successful for its own good. IBM, the giant of giants, had finally taken notice, organized its behemothian resources, and declared its entry into the fray. Is the announcement bad news for the competition? You bet, if the new IBM computer is a good one. Is it good news for the prospective computer purchaser? Again, the answer is yes—*if* the new Personal Computer proves itself worthy on its own merits.

Even mighty IBM has made marketing mistakes in the past. Product entries that didn't measure up were quietly retired after only a short exposure to the waiting world of savvy, no-nonsense purchasers. It could happen again.

So it comes down to this: Aside from the trumpet blasts of the introduction itself, apart from the media attention and competitors' tremblings; is the IBM Personal Computer *itself* a good product? During our recent excursion to the Delrey Beach, FL office to evaluate the system, we found it to be an intelligently conceived, soundly executed and thoroughly supported small computer. Its flaws are not insignificant, but they're correctable, given time and the continued devotion of an enthusiastic manufacturer. If you're shopping for a computer in this general performance range, it's worth the effort to go out of your way to inspect it. It's *definitely* a good enough machine to give the micro industry a run for its money.

The team was formed in August, 1979. A tight cadre of self-admitted personal computer nuts, the staff was housed in a forgotten building near Boca Raton, FL. Security was tight even by IBM standards, and the isolated assemblage of engineers, programmers and marketing specialists was left alone to father the Personal Computer. Synergy was the watchword during that event-filled year. The team hammered at ideas, conceived and rejected design approaches, argued over grand schemes and miniscule details. They went outside, too. Teams roamed the land to interview computer users, computer store proprietors and, we suspect, other computer manufacturers. Parts vendors

were consulted, and plans laid to use the best of what the coming years' technologies promise. By all the evidence, the development budget was enormous. The amount may never be published, but it was clearly in the mega-range for such a micro-computer. By the standards of anyone else in this business, the money available was almost unlimited.

Some of the ideas that came out of this melting pot of talent are very *un* IBM-like in the extreme. The one that excites us is Boca Raton's "open system" concept, wherein the computer's internal design is exposed to the world—friends and competition alike. Every pertinent detail of hardware construction and software design is not only available, but published in a clear, free and

## Be Your Own Systems House

Pick and choose from the following list to build the optimum IBM Personal Computer system:

| | |
|---|---|
| *Start with these...* | |
| System Unit, 16K & Keyboard | $1,265 |
| System Unit, Single Disk, 48K & Keyboard | 2,235 |
| *...and fill with...* | |
| Game Control Adapter | $ 55 |
| 16K Add-on Memory | 90 |
| Parallel Printer Adapter | 150 |
| Asynchronous Communications Adapter | 150 |
| Color/Graphics Monitor Adapter | 300 |
| 32K Memory Expansion Option | 325 |
| IBM Monochrone Display and Parallel Printer Adapter | 335 |
| 64K Memory Expansion Option | 540 |
| 2nd Diskette Drive | 570 |
| *...and add these...* | |
| Printer Stand | $ 55 |
| Printer Cable | 55 |
| IBM Monochrome Display | 345 |
| IBM 80 CPS Matrix Printer | 755 |
| *Don't forget...* | |
| Adventure | $ 30 |
| DOS with Advanced Basic | 40 |
| Asynchronous Communications Support | 40 |
| EasyWriter | 175 |
| VisiCalc | 200 |
| Pascal Compiler | 300 |
| Accounts Payable | 595 |
| Accounts Receivable | 595 |
| General Ledger | 595 |

## Two Ultimate Options

*The cheapest system...*

| | |
|---|---|
| System Unit, 16K & Keyboard | $1,265 |
| Color/Graphics Monitor Adapter | 300 |
| Adventure (why not?) | 30 |
| *Total* | $1,595 |

(plus TV, RF modulator & cassette)

*A full-house business system...*

| | |
|---|---|
| System Unit, Single Disk, 48K & Keyboard | $2,235 |
| IBM 80 CPS Matrix Printer | 755 |
| 2nd Diskette Drive | 570 |
| 64K Memory Expansion Option | 540 |
| IBM Monochrome Display | 345 |
| IBM Monochrome Display and Parallel Printer Adapter | 335 |
| Asynchronous Communications Adapter | 150 |
| 16K Add-on Memory | 90 |
| Printer Cable | 55 |
| Printer Stand | 55 |
| *Total hardware* | $5,130 |
| Accounts Payable | 595 |
| Accounts Receivable | 595 |
| General Ledger | 595 |
| Pascal Compiler | 300 |
| VisiCalc | 200 |
| EasyWriter | 175 |
| DOS with Advanced Basic | 40 |
| Asynchronous Communications Support | 40 |
| *Total software* | $2,540 |
| *System total* | $7,670 |

**People will get rich on this one, but the ultimate benefactor will be the computer user**

unambiguous style. The idea is to *encourage* other manufacturers to make things like displays and disk drives, general ledgers and games, and anything else that would be a useful adjunct to the system. It can only result in increased sales for IBM, we were told in sincere tones.

Have you seen these thoughts before? If you've followed the *Editor's Notebook* page of this magazine, you most certainly have. It's a point of view we've been encouraging for a long time. And now it's endorsed by none other than the premier computer manufacturer of the world.

Take the Technical Reference Manual, for example. Fat with design data of all sorts about the system, it includes an interfacing guide to the IBM bus (see figure 1), complete parts breakdowns, clear schematic diagrams of *all* circuits, and an 80-page listing of the source code for the first 8K bytes of the operating system software. A wealth of information is here; a fitting design manual to make your own computer. It's available for $36 at any ComputerLand store.

An important industry is already building in response to this invitation to prospective accessory manufacturers and software houses. People will get rich on this one, but the ultimate benefactor will be the computer user.

But all of this is nothing but an academic exercise if the machine is a poor processor, or even a mediocre one. Let's look at the bits and bolts, and see how the system measures up.

Spurning a current trend towards enclosing whole microcomputers in single, monolithic enclosures, the system adheres to a more scattered philosophy of architecture. Although not quite as extreme in this respect as the Apple II (at least the diskette drives are integrated), a fully-equipped Personal Computer can easily become the center of a tangled mess of wires on your workspace. A minimum system equipped for business use requires four pieces: the main computer, its keyboard, a display terminal and a printer. To this, one could add a cassette tape drive, second display, RF modulator, light pen, game paddles and communications modem. Although IBM's approach is perhaps not as elegant as some, it does have the advantage of allowing a great deal of flexibility in configuring the system, and of expanding it in the future with new hardware offerings.

The main computing block is called the system unit. It's a flat, rectangular structure measuring 20 in. wide by 16 in. deep. It stands only 5½ in. tall, and forms a perfect base for a video screen or small TV set. The weight is 21 pounds for the bare-bones version—seven more with a pair of diskette drives installed.

Internals of the system unit are tightly packaged. Most of the metal base is blanketed by the main system board. This card is a combination single-board computer and mother board to accept additional plug-in cards—again, a lot like the Apple II concept. The system board contains the central processing unit (CPU), 40K bytes of read-only memory (ROM) and from 16 to 64K bytes of random-access memory (RAM). It also contains the necessary electronics to drive a tiny speaker and an external audio cassette tape drive.

The microprocessor device is the 8088, designed by Intel. The 8088 is derived from the 16-bit 8086, which is at least a generation more advanced than the 8-bit chips to be found in most of today's microcomputers. The 8088 is an interesting hybrid. While it retains all of the 8086's internal 16-bit computing capabilities, it communicates with external devices (most notably the ROM and RAM memory) via an 8-bit communications bus. It's more than an 8-bit microprocessor; less than a 16-bit one. Perhaps our rigid definitions of CPU sizing are in need of updating. The speed given for the 8088 is 4 MHz for memory accesses; 2.44 MHz for complete CPU cycles. It's the former (higher) number that is usually quoted when comparing CPU speeds.

This computer's main circuit card also contains 16K bytes of soldered-in RAM, and plug-in connectors for an additional 64K bytes. The memory is expanded by inserting individual plug-in integrated circuit chips, a task many users will leave to their dealers. We anticipate that most owners will fill these spots up to the maximum in short order. RAM is cheap these days and getting cheaper; there's little sense in putting up with the inconvenience caused by a RAM-poor computer. At least 32K bytes of RAM must be fit if the unit has a floppy diskette drive.

The memory on this system, incidentally, includes a parity error detection capability. In its normal configuration, the processor will stop immediately (with appropriate diagnostic message) if a memory read error is detected. The idea is that it's better to halt a procedure than to continue with suspect data.

Sharing the space with the system board in the system unit are the optional minifloppy diskette drives,

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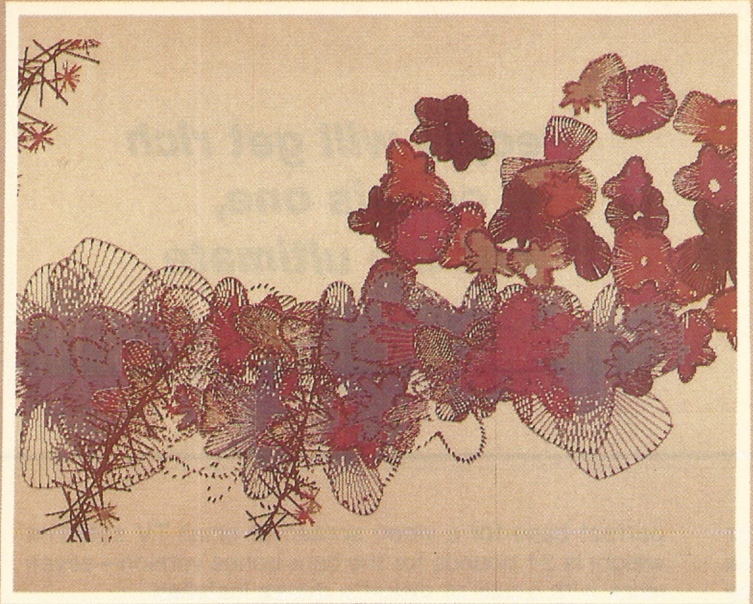


# Howard Ganz: Portrait of a Computer Artist

Text and photos
by Dona Z. Meilach

Imagine a huge wheel spinning incredible images onto floppy disks. At the turn of a switch, ideas, shapes and forms are released in a stream of magnificently programmed images. Each stream that pours forth is different—yet similar. Each expresses how the artist feels; each is a creative entity. No two are exactly alike. In fact, duplicates are unlikely.

Sound like a visionary thought? Futuristic? Like dipping a symbolic paintbrush into a computer chip, and finding a new kind of art? A new approach to computer graphics?

Howard Ganz has made that vision a reality. Today. In the present. With far reaching potential for the future.

Ganz is one of a handful of people with a background deeply rooted in art who has totally committed himself philosophically and practically to applications of the computer as an expressive art form. Ganz creates organic, natural forms as opposed to geometric shapes that we are accustomed to seeing. In so doing, he is charting —programming is a better word—a medium as new to the 80s as oil paints were in the early Renaissance.

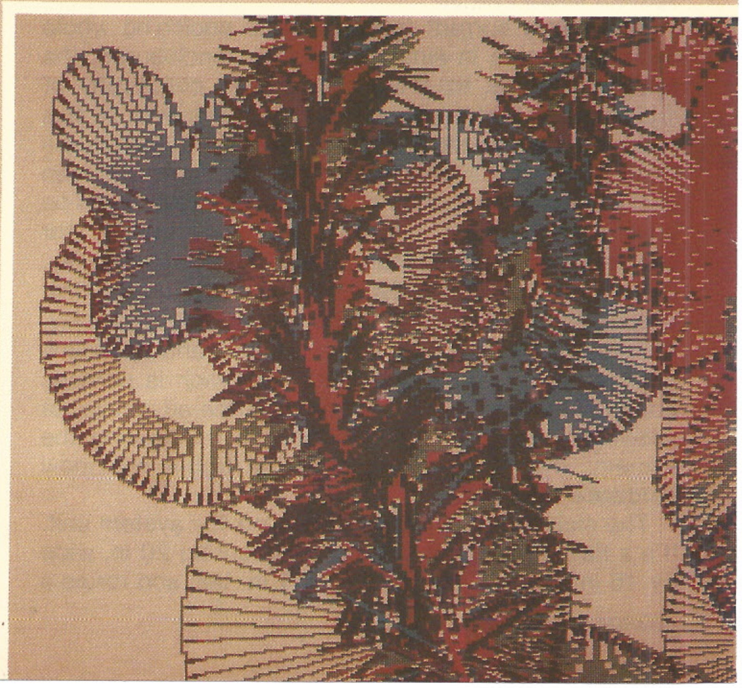
Perhaps Ganz's accomplishment could be more readily envisioned if you conjure an image of him as a modern Renaissance man. In addressing himself to the computer with the background of an artist, rather than a scientist or engineer, he has emulated 15th and 16th century Italian Renaissance artists. Those artists were the theorists whose visions led scientists to explore and evolve epochal discoveries. Lest you consider this literary hyperbole, imagine all the areas that Ganz has had to deal with: art, science, philosophy, psychology, theory and practicality—combined with patience and frustration. His unique theories are already raising new questions and logging new directions for both the scientific and art communities to deal with.

The first showing of Ganz's recent work at California's Southwestern College Art Gallery in September 1981 set a precedent for this new medium to be exhibited as a fine art. Most often, images produced by a computer have been termed "graphics."

What is the difference? For the purpose of this discussion, let's consider that *graphics* refers to a process where an original is created and many *exact reproductions* are made, as in any printing procedure. An artist or designer will create a single design, then duplicate it. *Art* denotes an *original* result with each image; no two are exactly alike, nor is the same image duplicated.

Ganz is a painter, sculptor, printmaker, art historian and art teacher at MiraCosta College, Oceanside, CA. With so many art disciplines at his fingertips, he brings a highly individualized set of experiences to the computer. Trained as an artist in pre-computer days, he had absolutely no background in computer technology, programming or math. Once aware of what computers offered, he said, "I knew what I wanted to do from the beginning. I wanted to find a way to deal with organic form in nature and use the computer to control the process rather than the final result." He reasoned that if he could control the process, he could produce variations rather than duplicates. With the proper orientation, the computer could be a potent vehicle for controlling the process.

But how? How could the computer, a scientifically controlled mechanical marvel, be utilized to create



something organic—changing so that it emulated nature's altering forms? In nature, a particular flower or tree is always recognizable, yet each one differs; no two are exactly alike.

Could the computer capture that same quality? Could the computer be used as a tool to follow processes like those of nature—not to imitate it, but to emulate its methods to result in organic imagery?

Ganz began to investigate the possibilities three and a half years ago, working rather clumsily through what was then available. The problem with the programs on the market was that they saved only the finished product and put that back on the screen in a quick scanning motion. They dealt almost solely with geometric images and their translation.

Says Ganz, "First of all, I wanted to make shapes that were irregular and organic-looking rather than geometric. I needed programs that would produce irregular curves and random textures. I wanted to be able to have the computer deal with randomness similar to what one finds in nature, with natural variations resulting.

After much experimentation, investigation, hundreds of false starts, and thousands of screen-peering hours, Ganz developed a program called Artist-Designer utilizing an Apple II computer interfaced with a color television. It saves the user's performance and runs all stages back on the program. It is like watching a step-by-step drawing process: it automatically saves all the procedures.

Ganz's initial programs were written in Basic. He also learned 6502 assembly language, but today he works mainly with Pascal. All were self-taught. The current forms use resources developed in his initial program, but the new programs are expert systems with their own intelligence. He says, "I used a mathematical splining routine so that I could set points anywhere on the screen and join them with curved lines to make shapes. I set points around a hub at various distances from the center and various degrees of a circle (polar coordinates). After that, the program joins them with a line, at the same time filling in all the spaces and creating a shape."

There is also a shading program that is similar to (but more sophisticated than) an Etch-A-Sketch. You can define a target pattern as large as the whole screen or as small as one pixel if you like. Using paddles, you can select and output a series of dots with the colors available in your system. There are actually five different drawing routines using the paddles almost as you would use a paintbrush: shading with dots, shaping, curved line drawing, a line stitching and a blocking in.

In Ganz's latest programs, the ability to produce variations is based on writing procedures that allow for random selections by the computer. He explains: "Instead of writing a procedure that tells the computer to output 50 dots every time, I have it output, let's say, somewhere between 40 and 60 dots. In all cases, I aim for a random factor. I can always define sets of form to be as broad or constrained as I wish. A random choice from such a set has defined bounds and probabilities. It's the computer that makes the final decision in each application. Each application is different, although the total form has the same look."

As an artist, how does Ganz feel about not having total control? "Actually, that's part of the excitement," he says. "You don't *have* to control everything; nature doesn't. So you control the important factors and then you allow the random base to pick up that difference. Everything is slightly different."

How does this affect the special qualities? For his purpose, it's perfect. His main interest is in two-dimensional space. He is not concerned with linear perspective that suggests three dimensions. He is not aiming for an architectural perspective or a three-dimensional image. While the forms are conceived and defined in two-dimensional space, it is exhilarating to observe that the more complex results have a great feeling of space and a dynamic motion.

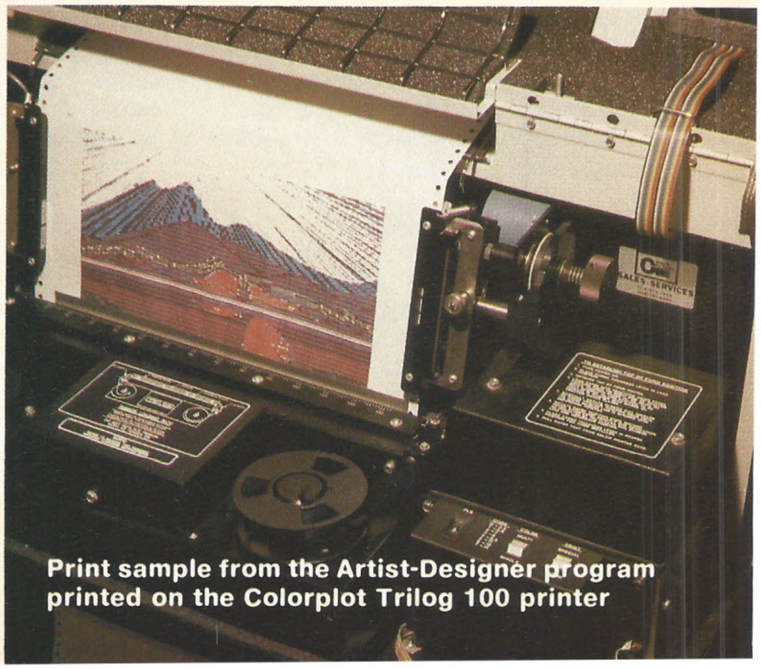
### Organic vs inorganic forms

It is easier to understand why with the artist's articulate explanation. "Organic form is anything produced in a natural realm, such as bones, plants, sea forms. Such objects have randomness as their base. Compare this with inorganic form, which is manmade *and* mechanical and has as its base a coordinate or counting system of regular numbers. When inorganic form moves to its base, it is a grid or checkerboard rather than the random cluster of an organic base.

"The problem of building organic form involves structuring art at levels of random description. In science, randomness is a lack of order. In art, random patterns seem recognizable, so it is possible to deal with them as a type of order. I might begin with a series of dots and group them closely together for a nucleus or a cluster. I can place the individual dots randomly, while the group of dots can be selected within a predicted location and defined density. The result is an ordered nucleus, yet a randomly placed concentration of individual dots."

All forms in Ganz's latest programs are also defined using a set of descriptors; these enable him to tell the computer the type of forms he wants in the design. As his system evolved, he realized that he wanted to be able to have the computer produce, on command, a variety of types of characters. Each character type could evoke particular feelings. Now he can write programs that, to some extent, will produce predictable emotional responses.

An entire shape system is produced, based on shape clusters that change and alter from positive, solid



**Print sample from the Artist-Designer program printed on the Colorplot Trilog 100 printer**

shapes with warm colors to negative, open shapes with cooler colors. Some are very static and regular with hardly any ripples; others are defined as dynamic and irregular. They also range from simple to complex.

Each descriptor can be defined on a scale of 11 steps. By combining the descriptors, the artist can achieve some of the 1,331 possible variations. Through these choices, the computer will produce images that

**"...The highest degree of creativity in computer art... is in the programming and software."**

are a creative, expressive art form based on selectivity and randomness. No two pieces are identical. All are similar of their type—but with variations.

For printing his images, Ganz has interfaced his Apple II with a Trilog Color Plot 100 printer, one of the few color impact printers on the market. It works from a three-colored ribbon consisting of red, yellow and blue. There are 100 dots per in. horizontally and vertically. It is completely programmable, so he can mix the dots to make any color he wants.

The system is not without its problems, emphasizes Ganz. But once you work them through, it is feasible. The Apple II does not work with the same colors as the printer. Ultimately, you have to do a color separation and mix the color from the printer's primaries.

To produce the large prints that measure 38-in. by 28-in., it was necessary to overcome other technical problems. The Apple resolution was not adequate for his current work. So Ganz evolved a system using nine screens and combining them in a 3 by 3 matrix. The printer then outputs three strips.

Says Ganz, "Actually, I created files on disk storage for each screen so there are nine screens stored on a disk, though only one appears on the screen at a time. Then I wrote a system that scrolls between the screens. Another program checks to see if the drawing being produced is going to draw off the screen, so that when the drawing begins to exceed the boundaries, the drawing stops. Then the screen scrolls and gets the next increment of drawings. It draws until it goes off the screen again, then calls out another increment of drawings and continues."

### Time-consuming process

The drawing process itself is lengthy and tedious; some of the larger works require up to 12 hours to design and store. Then it takes one hour and 20 minutes to print these nine screen drawings. Of course, this work is controlled by the computer without user supervision.

Another problem is the intensity of color; it tends to lessen as the ink is discharged from the ribbon, and fades. Ribbons are costly, so printing with a re-inking system would be ideal. He is also looking forward to the development of more permanent inks. He has investigated printers that operate with ink jets instead of a ribbon. So far, there is still trouble with those he has seen, because the paper does not accept the ink uniformly and the color dots have a tendency to bleed into the paper.

Working through his processors—defining, experimenting, redefining—has enabled Ganz to capture several exciting theories about the use of the computer and our environment. For example, he says: "I'm concerned with our production systems. Why must we have standardized objects all the time? Take chairs, for instance. We've become so adept at duplication since the industrial revolution, we've become accustomed to it. Have we created a delusion that things *have* to be identical? Before the industrial revolution, chairs had variations for size, material. Everything in nature has variation. How much more interesting and natural our lives could be if the objects of our environment were produced with variations."

Ganz's theory about production systems evolved as he worked through his own processes. He says, "At one time, I thought a design had to be absolutely perfect, exactly what I had planned. I was afraid I would make a mistake. I was uptight. Then I decided that sometimes happy accidents were better than those I planned. So I relaxed and said, 'Well, let's see how it's going to work.' When I compared my attitude to nature, I looked around at plants that adapted when all the 'perfect' factors were not present...such as poor soil, inadequate light. Yet the plant grew. Adapted. Was identifiable. That is the idea I worked with."

### Effects on artistic expression

Does the computer limit creativity? Or expand it? "At present," believes Ganz, "the highest degree of creativity in computer art, as I see it, is in the programming and software. The artist should become involved with writing programs that will express his feelings and ideas. The few artists who are involved now usually write programs that create forms and shapes similar to those they explore in their own paintings. My computer-produced forms are not that different from my paintings because I addressed my problems to creating that kind of form. Certainly my designs, in their infinite variations, should not cover the world. There should be as many designs and variations as there are people making them with their own unique variants."

What does Howard Ganz hope to produce next? "I'd like to see computers interfaced to automated factories to produce chairs, tables, wallpapers, textiles, prints and things like that with individualized variations. We would have to go through a period of consumer re-education because we've become so accustomed to wanting what we see in a catalog, on a showroom floor, or in our neighbor's house. But that's far in the future."

Until then? "In the meantime," replies Ganz without a moment's hesitation, "I want to make my programs more intelligent and achieve more interaction between program and screen. I would like to make screen searches and let the program see what's on the screen before it makes the next step. It's a complicated procedure, for which I need more sophisticated equipment. But I'll get there."

There's no doubt about that. Most likely, Howard Ganz will have an entire retinue following him. □

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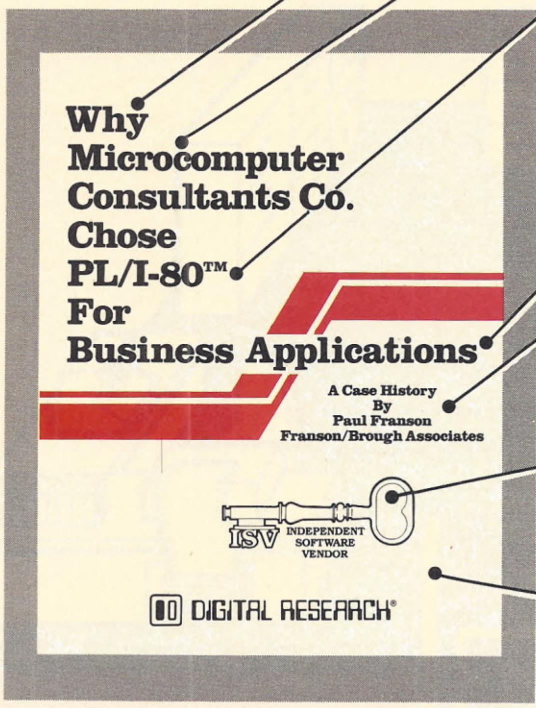


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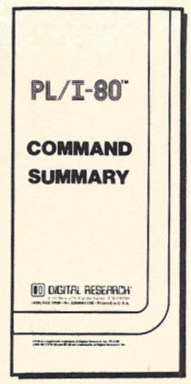


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# DRAFTING YOUR OFFICE FLOOR PLAN

by David D. Busch

Computer-aided drafting will someday replace manual drawing for all but the simplest design chores. Innovative companies, such as Boeing Aerospace in Seattle, WA, already have the capability of going from an engineer's idea to templates and tooling without committing a single line to paper. Such sophisticated tools are becoming available to the small business person equipped with a microcomputer. Although some business-oriented systems do not have the high resolution graphics capability and the number-crunching power of the dedicated graphics terminals, they still offer some valuable capabilities.

As an example, here is Floorplan, a tool that can be used to lay out some simple office floor plans, using a TRS-80 model I and a printer with graphics capability. It allows drawing and subdividing an office area about 30 feet square, and putting in items of furniture such as desks, tables, file cabinets and chairs at the press of a button. The program serves not only as a demonstration of what more powerful graphics terminals can do, but also what can be accomplished using a relatively low resolution system.

Unlike the Apple II and other hi-res microcomputers, the TRS-80 can deal with graphics blocks, or picture elements (pixels) in a matrix only 127 by 47. Less than 6,000 pixels are available for TRS-80 graphics in normal mode. By clever use of alphanumeric characters, or the special graphics characters provided to users of model III Basic, designs that appear to be more detailed can be constructed. However, Floorplan provides some useful features using only the standard 127 by 47 matrix.

How is computer design of this sort faster or more efficient than traditional methods? Floor plans can be juggled by using a gridded sheet and cutouts representing furniture. However, it is time-consuming to transfer the finished plan to paper for permanent storage. When the design is drawn by computer, the user simply directs the output to a printer capable of producing graphics characters, and has a hard copy available for permanent reference. Floor plans can also be drawn on paper for long-term storage. However, it is less easy to shuffle items around and rearrange the layout. Tedious erasures must be done to make even the simplest change.

## Macro command utilized

This program borrows from its more powerful counterparts by the implementation of the so-called macro command. CAD/CAM manufacturers call these by different names: quick actions, menu commands, and so forth. They allow the user to draw an often-repeated element simply by hitting one or two keys. In this program, a complete desk may be drawn by entering a character that represents that item of furniture. The appropriate graphics symbol is drawn in proper scale automatically.

To use the program, the designer first draws the outlines of the room. The arrow keys of the model I are used to direct the placement of lines. Any shape room may be drawn, and walls are put in the appropriate places if you are subdividing a larger space. As the cursor moves across the screen, drawing a wall, a readout constantly indicates how many feet have been paced off so far. Because of the limitations inherent in using fixed-sized pixels (which draw a digital rather than analog wall), a given increment may not correspond exactly to the dimensions of the room you are drawing. An approximation will have to be settled on.

For example, a room that measures 20 ft., 2 in. along one wall may have to be drawn as 20.00 feet, because the horizontal lines are incremented in half-foot steps. Vertical lines are slightly more complex, because the TRS-80 pixels are taller than they are wide. A drawing approximating a square room will require more pixels horizontally than vertically. To maintain approximately the proper scale, an odd increment had to be used within the program. Again, the user should stop drawing a line when the wall is close to that desired.

## Scale is simplified

To keep the program simple, a single scale was chosen, allowing drawing a room that is about 30 feet square. If you wish to work on a larger area, or subdivide an entire floor, it would be advisable to work by sections, or room by room.

The true scale, visually, will vary with the size of your monitor, and in hard copy according to the number of columns per inch from your printer. It is doubtful whether the accuracy of this program is sufficient to make determining true scale worthwhile, in any case.

Using the footage readout as a guideline, the user draws the desired room, and then hits ENTER to indicate that he or she is finished. Graphics symbols representing various pieces of furniture then appear at the bottom of the screen, and a cross-hair cursor is positioned within the drawing.

The designer can then move the cursor around, using the arrow keys, until the approximate position desired for a piece of furniture is located. The item is drawn simply by hitting the appropriate key—D for desk, C for chair, T for table. As single letter commands, these are all drawn horizontally, in relation to the screen. By hitting a control key (the @ sign) prior to striking a furniture key, the desk or table will be drawn vertically. File cabinets and chairs are approximately square and appear the same horizontally or vertically.

To erase a graphics character, position the cursor at the right or left of the item and hit R (for rubout). If part of an object is erased by mistake, finish the job and redraw it. In this manner, objects may be drawn, erased, and redrawn in new locations until the design is finished.

Newdos 80 users, and others with a screen printing utility, can have a hard copy of their finished designs just by hitting JKL or whichever command is appropriate for their DOS—assuming they have a printer with graphics capabilities.

Floorplan is a limited-capability program that does demonstrate the capabilities of even a low resolution system like that available for the TRS-80. Users can

modify it to suit their needs—adding other items of furniture, changing scale and so forth. As an aid to modification, let's review how the program works.

The first step is to draw the room. An INKEY$ strobing loop of the keyboard (line 250) looks for input until a key is hit. If ENTER is input (CHR$(13),), indicating that the design is finished, control goes to the furniture placement routine, which begins at line 600. Otherwise, the program drops down to check for one of the arrow keys (CHR$(8), CHR$(9), CHR$(10) and CHR$(91) in the model I).

If an arrow has been entered, the program checks variable FLAG to see if the user is asking to reverse direction (not allowed in this program). If so, the input is rejected, and control goes back to the INKEY$ loop.

If FLAG is an allowable value, the variables representing movement along the X or Y axis (as appropriate) are incremented to produce the desired change. That is, the computer will SET(X,Y), with the value of X or Y changing, depending on the arrow key depressed. If the right arrow key has been hit, X will be incremented by one. If the left arrow is struck, X will be decremented by one. Upward movement causes Y to be decreased by 64 (the number of pixels in one complete line), while down causes Y to be increased by 64.

Error checks refuse input that would cause the cursor to travel beyond the boundaries of the screen. Next, variable T, which measures how many scale feet have been drawn by a given line, is changed. If the current input character equals the last one input (FLAG), then the program knows that the cursor is proceeding in the same direction, and T is incremented by one. If the current character does not equal FLAG (the direction has changed), T is returned to zero to begin counting in the new direction. FLAG is then changed to indicate the new direction, and a factor (F) altered.

For each pixel horizontally, the cursor is judged to have moved one-half foot, so F is given a value of 2. For vertical movement, F is assigned a value of .85 to account for the larger steps.

At line 600, the furniture placement routine begins. Another INKEY$ loop looks for input, allowing arrow keys to position the cursor, alpha characters that indicate an item to be drawn, or the control character @. The new position of the cursor is POKEd directly into video memory—but only if the location already contains a space—32.

If an arrow key is depressed that would send the cursor into an area already occupied by a wall or furniture item, the input is refused (as in line 690).

When the @ is entered (at line 640), the vertical flag (VFLAG) is set to one until the next character is input. When keys are depressed indicating that a piece of furniture is to be drawn, the appropriate graphics subroutine is triggered (as in lines 900-920). VFLAG is always returned to zero, to await the next inputting of the @.

Adding new graphics blocks is as simple as defining them to approximate scale, inserting an appropriate key to represent input for that item, and devising a routine modeled on the others to write it to the screen.

Changing the scale of the drawing can be accomplished by altering the value of F as changed by horizontal and vertical movement of the cursor. □

**Program on page 150**

# DECSTR—The Superbroker

by Rocky Smolin

S. Tracy Rodgers is a closet programmer. By day, he is an investment executive for the La Jolla, CA branch of Shearson/American Express. Behind his desk in a private office of this staid but fashionably-appointed brokerage firm, gray-haired Tracy Rodgers is pure Brooks Brothers. He manages accounts for a variety of clients, whose portfolios range from fast-paced commodities futures to blue chips, bonds and money market funds. But there is something unexpected behind this pin-stripe exterior. After the market closes, you can follow him past the chattering news-service machines to the back of the office, where a clerk sits keying the day's price changes into a DEC 310. And here is where Tracy Rodgers, system designer and programmer, comes out of the closet.

Tracy is the creator of the DECSTR Superbroker system (DEC for Digital Equipment Corp., Maynard, MD; STR—his initials). DECSTR (pronounced dexter) can keep track of the daily price movements of over 1,200 commodities, options, bonds and stocks. The system can also track the portfolios of over 580 different customers, updating a maximum of about 3,800 different positions on a daily basis. It gives Tracy comprehensive reports on his customers' positions, profits, losses, portfolio performance and cash balances. He can get audit trails of journal entries and recording issues along with receipts of cash, dividends, interest and the like. DECSTR will even show him everyone in the data base who has a position in a given security.

Pride of authorship is apparent as Tracy explains the history of DECSTR. "The first version was completed in 1961. We ran it on an IBM 1410 initially, at the General Atomic plant in Torrey Pines. It was written in Fortran and everything was done on punched cards. The company was real happy to have someone to sell some of its excess time to, and my customers were tickled to death to have this kind of service provided by their broker.

"By 1975, however, G.A. had gotten busier and discontinued service to outsiders. I tried for a year to get along without computerized portfolio management, but it was very frustrating. Once you become accustomed to the convenience, accuracy, and timeliness of automated information, it becomes very difficult to live without it. Besides, I felt it gave me a definite edge over the other brokers."

So in 1976, Tracy bought the DEC 310, with two 8-in. disk drives and printer, and tried to recruit help to assist in the conversion. After two programmers had started, then abandoned the project, Tracy set out to teach himself DIBOL (he already knew Fortran from the G.A. experience) and commenced what turned out to be a two-year program development effort.

"I had to practically rewrite everything that had been done to that point," he related. "I wanted the system to be easy enough for a clerk to operate, and the outputs to be comprehensible to any securities person, regardless of his computer background."

Standing before the machine, Tracy warms to his subject. "Every broker or investment manager who deals in commodities, options, stocks or bonds, will understand and appreciate having his bookkeeping done in this manner. Easy entries through the keyboard cover customer purchases, sales, cash receipts, cash

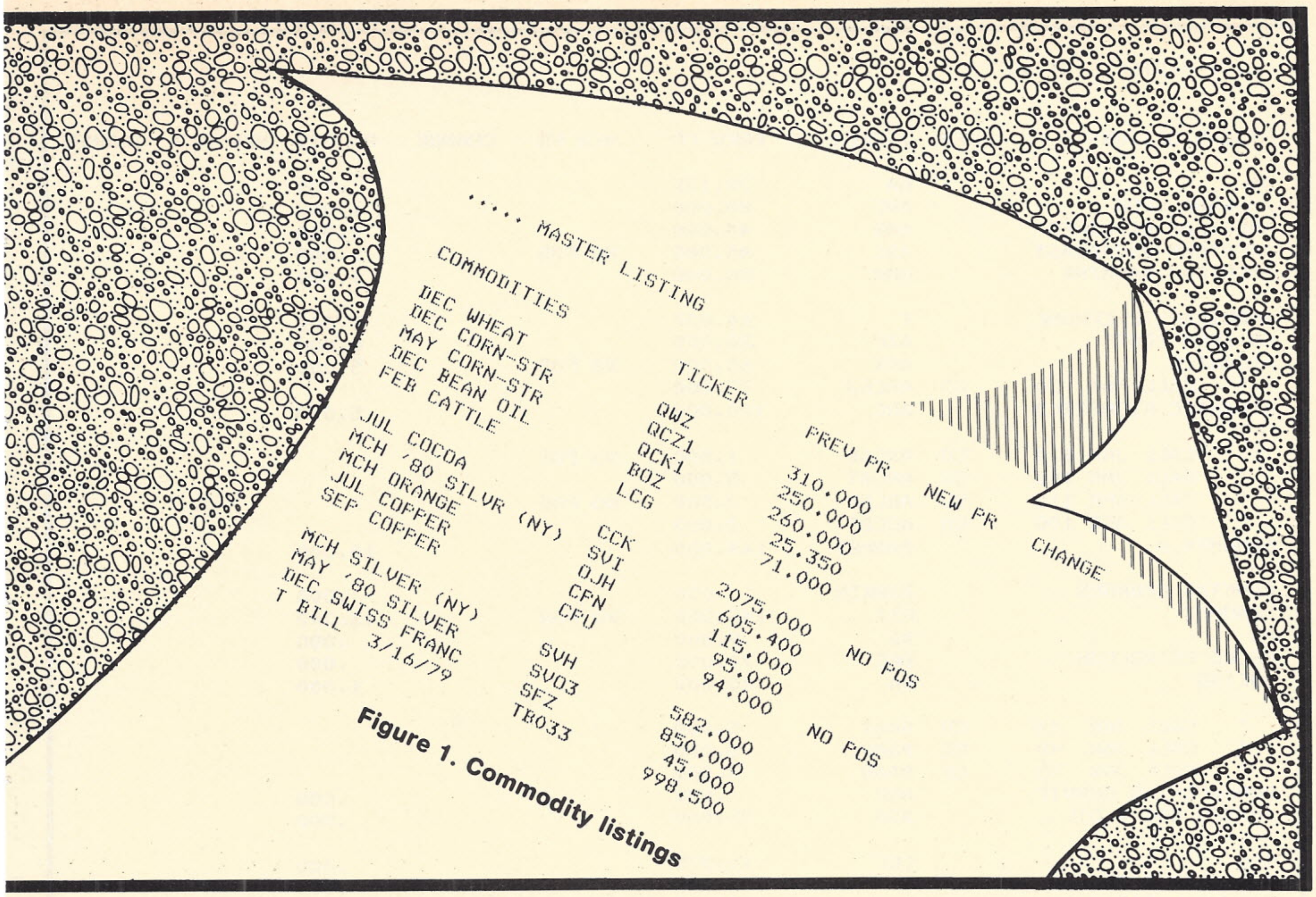

**Figure 1. Commodity listings**

payouts, dividends, etc. The system provides statements of customer accounts. Equities, margin requirements, details of positions held, profits or losses overall and by position, year-end reports for income tax preparation, listings by customer or position—all updated to the current market, are readily available.

There are already a few DECSTRs in use. The first one was delivered to Hunter and Associates of Newport Beach, CA, who bill themselves as "Futures Commission Merchants." The second one was delivered to Schwartz and Hofflich of Norwalk, CT. Yet another machine can be found at Pasquinelli and Co., investment counselors of Monterey, CA.

I pressed Tracy for some better idea of who would use such a system. "Originally, I thought that brokers like myself would be wild for it. But most of them are in sales, if you know what I mean. They spend the bulk of their time watching individual issues, reading the house research reports, and talking to their customers. They leave the accounting to someone else. Where I actually get more interest is from portfolio managers, bank trust departments, and the like. They really appreciate the clarity of the reports, as well as the auditability of all the transactions that pass through the system."

"However, with the increase in the storage capacities and multi-user capabilities of the small DEC computers, particularly with the advent of hard disks for micros, DECSTR becomes a real useful tool for brokerage offices with five to ten brokers. Add on a word processing package and a financial planning tool like VisiCalc, and you've got a real competitive edge."

A look at the reports produced by DECSTR demonstrate the system's capabilities. Figures 1 and 2 show listings of commodity and stock masters respectively. The system can also support multiple offices as well as multiple brokers within each office. The detail of a client's current position can be extracted any time. These reports can be displayed on the screen as well as printed.

"Sometimes, a broker will become very involved in one issue, recommending it to his clients, and buying it for discretionary accounts (those that the broker manages for a client)," adds Rodgers. "Knowing how deeply he is committed to this issue, on whose behalf, and what the current status of these positions is, can be a headache and a source of worry to a broker." Thus, he created open position reports. This format also satisfies the requirements of government reporting for commodity accounts.

The audit trail produced from the journal entries program is an important source of information to the customer as well as an invaluable backup for the broker. The closed position reports are favorites of his clients. Not only do they show the profit or loss on each trade, but the trades are divided between long and short-term, making it an ideal document to submit to an accountant at tax time.

This by no means exhausts the copious reporting capabilities of DECSTR. And there may be more on the way. "I'm in the process of upgrading the system to double density, floppy capacity, and I have some great ideas for additional reports. The new hardware is called the DECMATE work processor (model WS278). With two drives and a 180-cps printer, it costs about $6,800. Add my software, which is $4,000, plus a few accessories, and the whole investment comes in under $12,000.

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| STOCKS/OPTIONS | EX | TICKER | PREV PR | NEW PR | CHANGE | PR DIV | NEW DIV | CHANGE |
|---|---|---|---|---|---|---|---|---|
| AA | | AA | 20.125 | | | .000 | | |
| AMERADA HESS | | AHC | 80.000 | | | 1.000 | | |
| AMERICAN AIRLINES | | AMR | 45.000 | | | 2.000 | | |
| AMERICAN BROADCAST | | ABC | 45.000 | NO POS | | 1.000 | | |
| AMERICAN MACHINE | | AMM | 50.000 | | | 1.000 | | |
| AMERICAN TELEPHONE | | T | 64.000 | | | 5.000 | | |
| ARIZONA POWER | | AZP | 20.000 | | | 8.000 | | |
| ATLANTIC | | ARX | 65.000 | NO POS | | 5.000 | | |
| " CALL MAY 50 | CO | ARCEJ | 95.000 | | | | | |
| ATLANTIC RICHFIELD | | ARC | 100.000 | | | 5.000 | | |
| " CALL JAN 110 | CO | ARCAB | 1.500 | NO POS | | | | |
| " CALL JAN 100 | CO | ARCAT | 5.000 | | | | | |
| " CALL APR 110 | CO | ARCDB | 2.500 | NO POS | | | | |
| " CALL APR 100 | CO | ARCDT | 2.000 | | | | | |
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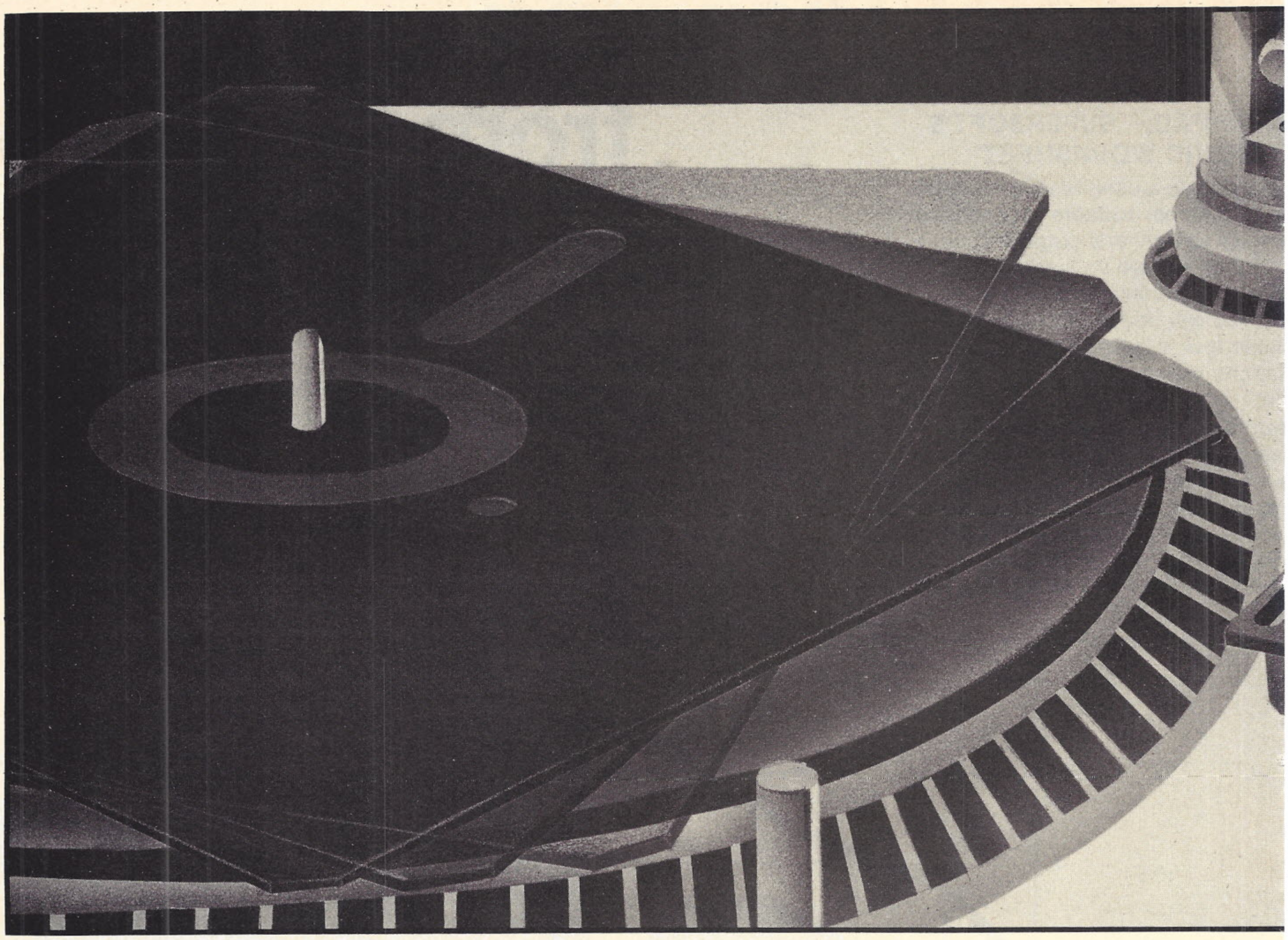
| " CALL JAN 35 | CO | BAAG | 5.000 | | | | | |
| BOOKKEEPING SERVIC | | BKP | .000 | | | .000 | | |
| BUTTES GAS & OIL | | BGO | 25.000 | | | .000 | | |
| CCC | | CCC | 15.875 | | | .000 | | |
| CHRYSLER CORP | | C | 4.000 | | | .000 | | |
| COLUMBIA GAS | | COL | 80.000 | | | 5.000 | | |
| D J CANTRAL ASSOC | | DJC | 50.000 | | | 1.000 | | |
| DD | | DD | 61.500 | | | .000 | | |
| DIGITAL EQUIPMENT | | DEC | 55.000 | NO POS | | .000 | | |
| EASTMAN KODAK | | EK | 81.000 | | | 2.125 | | |
| " CALL APR 60 | CH | EKDL | 6.000 | | | | | |
| " PUT JAN 65 | CH | EKMM | 7.000 | | | | | |
| EE | | EE | 73.000 | | | .000 | | |
| FABREGE | | FBG | 7.500 | | | .700 | | |
| GARDENING SERVICE | | GARDEN | .000 | | | .000 | | |
| GENERAL MOTORS | | GM | 50.000 | NO POS | | 5.000 | | |
| GENERAL SIGNAL | | GSX | 50.000 | | | 2.000 | | |
| HASH SAME AS CMB | | GO | 50.000 | | | 1.000 | | |
| HASH SAME AS GO | | CMB | 50.000 | | | 1.000 | | |
| HASH SAME AS MOB | | SWX | 45.000 | | | 1.000 | | |
| HASH SAME AS SWX | | MOB | 85.000 | | | 1.000 | | |
| INT BUS MACHINE | | IBM | 66.625 | | | 3.500 | | |
| NATIONAL SEMI COND | | NSM | 45.000 | | | .000 | | |
| PENOLES A | | PENOLS | 1600.000 | | | 15.000 | | |
| POGO PRODUCING COM | | PPP | 182.000 | | | 2.000 | | |
| RALSTON PURINA | | RAL | 50.000 | | | 3.000 | | |
| STD OIL CALIF | | SD | 110.000 | | | 5.000 | | |

**Figure 2. Stock master listing**

What's in the future for Tracy Rodgers? "I'd like to write an interface program to access the closing stock prices via modem," he asserts. "Then I could eliminate the manual input of the daily closing prices of all the issues in the master file. I'm also thinking of converting it to Fortran or Cobol to make it available to a wider variety of computers."

How does he like being a software designer and programmer? "I'm a broker," he claims. "I have been for over 20 years and it's really my living, my career, and the fulfillment of my life's work." Somehow, as I closed the door of the Shearson office behind me and looked back to see Tracy happily keying away at DECSTR's well-worn keyboard, I didn't believe it.☐



When using diskettes to store valuable data that is frequently updated, it is a good practice to periodically make a copy of the data on another diskette. This will provide protection against loss of the data if the original diskette is damaged or becomes unreadable.

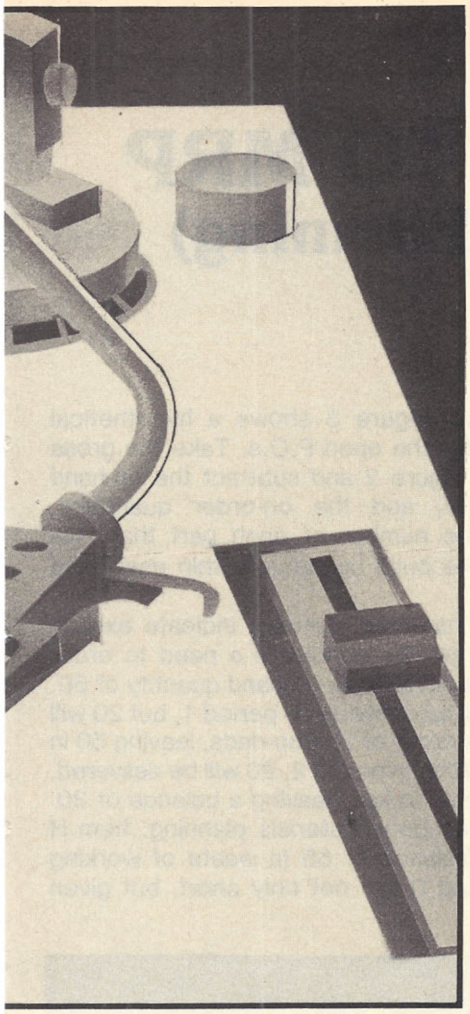
After copying the data from the original version, a diskette that contains a copy of the data should then be used for updating information. This will rotate the use of the diskettes so that none receives substantially more wear than the others. If this is not done, the original diskette—the one subject to the most use—will probably fail long before the others. When this happens, the diskette will have to be replaced and the data restored; but it will be uncertain if the other diskettes will need replacement—and how much longer they can safely be used. There are two choices: 1) continue using the other diskettes until they fail (requiring that the data on them be restored); or 2) discard the other diskettes, though they may have a lot of useful life left.

In the early days of computing, use of magnetic tapes for storing computer data was common. A magnetic tape, like a diskette, is subject to failure after long use. A system was devised to ascertain how much longer a magnetic tape could be used and to provide protection for the data stored on the tape. This system, which requires three magnetic tapes, is based on copying the data periodically from one tape to another and using the last tape copied as the main input/output tape for updating the data. By doing this, the wear is spread evenly among all three tapes. When the tapes near the end of their rated life or exhibit failures from excessive use, the data is then copied to new tapes and the old tapes are discarded. This system is called the grandfather system.

Because of the similarity between diskettes and computer magnetic tapes, the grandfather system can be used for spreading the wear over three diskettes while protecting data on them. The system is based on using three tapes or, in this case, diskettes. When the data is put on the first diskette, this diskette is used as the input/output diskette for updating the data. When it is determined that a copy of this initial diskette is desired, it is copied to the second diskette. This diskette will contain exactly the same data as the initial diskette (i.e., it is as current as the initial diskette). This establishes a two generation father-son relationship between the two diskettes. The original is the father diskette and the new one becomes the son diskette. The son is now used as the input/output diskette for updating the data, and the father is safely stored somewhere in case something happens to the son. This son will now receive approximately as much wear as the father has received.

Now, if something were to happen to the son (for example: coffee spilled on it, touching the surface with a finger, or read and write errors developing), the data can be restored from the father. This data is the same as the data on the son when it was created. While it will require some work to update the contents of the father so that it is identical to the unusable son, it will be far less work than reconstructing all the data on the son.

When it is determined that a copy of the son is to be made, the son is copied to the third diskette. This



# ROTATING DISKETTES

by Frank B. Rowlett, Jr.

establishes a three generation grandfather-father-son relationship among the three diskettes. The third diskette is the new son, the old son now becomes the father, and the old father now becomes the grandfather (hence the name grandfather system). Now both the father and grandfather are stored in the event that something happens to the son.

The grandfather is a backup to the father. If something happens to both the son and father, the grandfather can be used to reconstruct the data. Again, while it will require more work to update the data on the grandfather so that it is identical to the data on the unusable son, it is less work than reconstructing all the data on the son.

Thereafter, when a copy of the son is made, it is copied to the grandfather. Thus a cycle is established where the old grandfather becomes the son, the old son becomes the father, and the old father becomes the grandfather.

The diskettes should now receive approximately the same amount of wear since each spends approximately the same amount of time as the input/output diskette for updating the data. When it is determined that the diskettes are near the end of their rated life or when one exhibits failures from excessive use, all three can be copied to new diskettes and the old ones discarded.

One thing must be done carefully—and without fail—with this system: *the diskettes must be accurately labeled.* It is not necessary to label the diskettes as son, father and grandfather; it is only necessary to label them with the date (and time, if copies are made more than once a day). Thus the diskette with the oldest date is always the grandfather, the next oldest date is the father and the diskette with the youngest date is the son.

If it is felt necessary to make two copies of the son diskette, *do not make them on the father and grandfather.* Use two sons, two fathers, and two grandfathers, and alternate the use of each generation to evenly distribute the wear on all diskettes. Keeping three generations of diskettes protects against having errors in the data introduced by some form of system failure, which might not be detected immediately, and spread immediately to all three diskettes. The result could be, depending on how the computer programs delete and add information to the data file, loss of one or more pieces of information in the file with no easy way to recover it.

Four or more diskettes can be used in this type of system (although more than three diskettes would not be, strictly speaking, a grandfather system). The procedure is the same—the newest diskette is always copied to the oldest one. Using two diskettes does not provide sufficient protection in the event that both become unusable at the same time.

It is desirable to keep both the father and grandfather in a location other than where the son is stored. The reason for this is that something might happen that damages all three diskettes simultaneously (for example: fire or water damage, or improper handling). If the father and grandfather are stored elsewhere, they will still be available to reconstruct the data. □

# AN INTRODUCTION TO MRP
## (Materials Requirements Planning)
## Part II

by Rocky Smolin

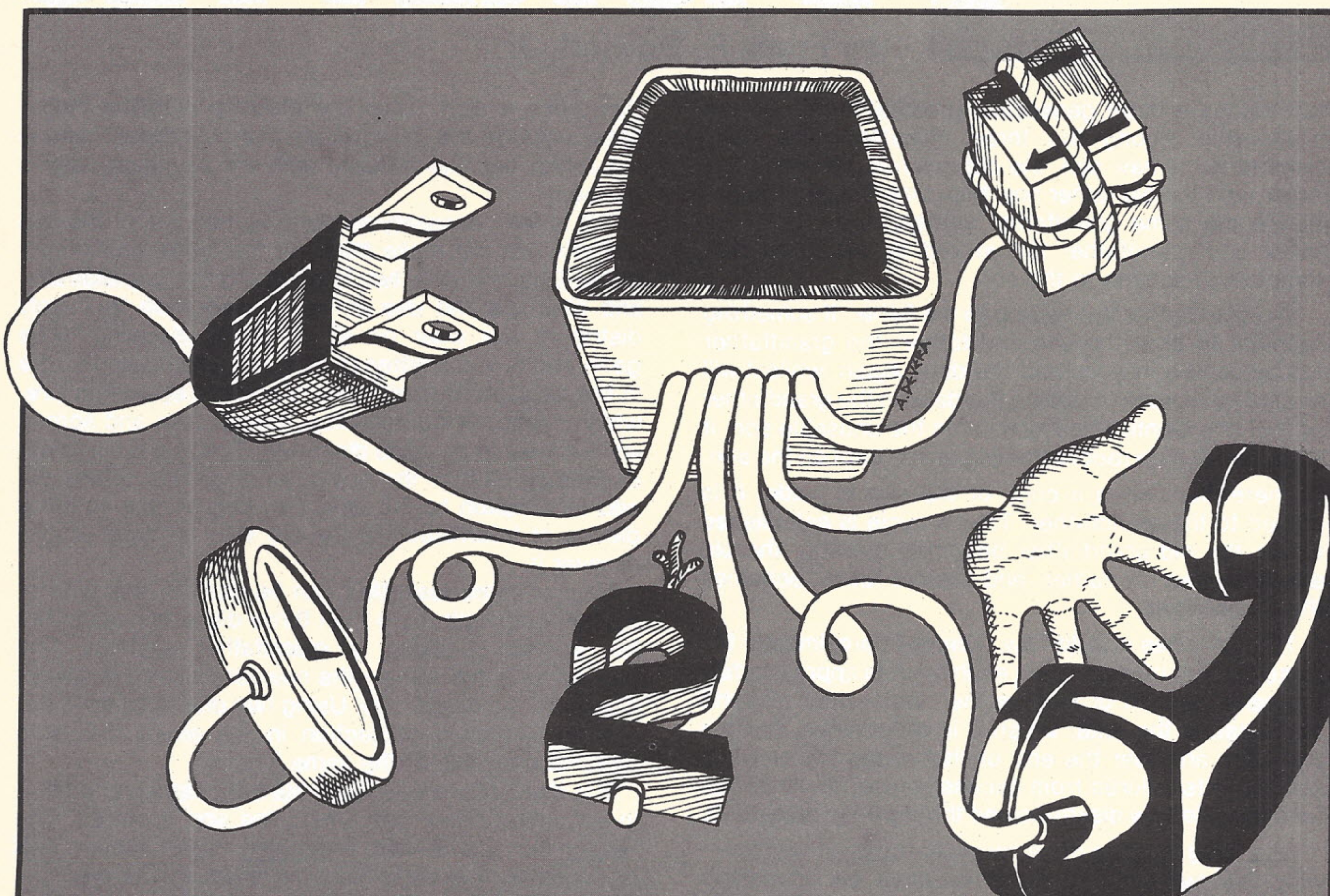
*Last month's article introduced the MRP (Materials Requirements Planning) concept, explained its purpose and presented the initial steps in implementing an MRP program. This month's concluding installment demonstrates the method for processing a work order and offers a discussion on the pros and cons of the MRP method.*

Given the build schedule in figure 1, MRP can determine what components or purchased parts are required when the work order is to be sent to the floor. The assemblage of parts required for a work order is known as a kit. Figure 2 shows the gross requirements for components, given the build schedule in figure 1.

From these demands for components, we must subtract the supply factors of the on-hand quantities and the future deliveries that can be found in the open purchase order file. Figure 3 shows a hypothetical delivery schedule for the open P.O.s. Take the gross requirements from figure 2 and subtract the on-hand quantities (figure 4) and the on-order quantities. What remains is the number of each part that falls short of meeting the build schedule within each time period (figure 5).

Here again, the negative numbers indicate excess inventory; positive numbers indicate a need to order more. Item A starts out with an on-hand quantity of 50. An additional 20 will be delivered in period 1, but 20 will be kitted for a work order of 20 doo-dads, leaving 50 in raw materials inventory. In period 2, 20 will be delivered, but 40 will be needed in kits, leaving a balance of 30.

MRP has revealed poor materials planning. Item H has a continuous balance of 55 (a waste of working capital). Items B and D are not only short, but given



| | Time period 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Widgets | 0 | 20 | 20 | 20 | | |
| Doo-dads | | | 20 | 40 | | |

**Figure 1. Build schedule for widgets and doo-dads**

^

| | Time period 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| A | 20 | 40 | | | | |
| B | 200 | 400 | | | | |
| C | 40 | 80 | | | | |
| D (for doo-dads) | 180 | 360 | | | | |
| D (for widgets) | 0 | 60 | 60 | 60 | | |
| D (total) | 180 | 420 | 60 | 60 | | |
| H | | 20 | 20 | 20 | | |
| I | | 40 | 40 | 40 | | |

**Figure 2. Gross component requirements**

their lead times of one period, this shortage cannot be overcome in time to complete the kits for period 1. If MRP goes on to set back the raw materials requirements by their lead times, we will have to buy requirements for the widgets and doo-dads. Items that are overdue for ordering will be shown in negative time periods (figure 6).

Items B and D will not be present in sufficient quantities to fill the kits in period 1. The need to order an additional 80 and 100 units respectively was overlooked in the last period, resulting in shortages that will cause idle labor time and perhaps lay-offs (if material shortages are severe enough). Production bottlenecks, when the parts finally do arrive, may mean overtime premiums, temporary help, manufacturing inefficiencies and low worker morale.

Too many small and medium sized manufacturing concerns operate in a crisis/rush/expedite mode that they consider normal. The complexities of forecasting, forward materials procurement, shop floor loading and capacity planning in a manual mode overwhelm the expertise and resources of management. Seat-of-pants becomes the rule—and its concomitant: high personnel turnover.

Although implementing MRP is a long and arduous task, the system is its own reward. The success stories in the manufacturing world are beginning to outnumber the failures.

Despite its obvious advantages, too often MRP fails to live up to expectation. The primary reasons are bad data in one or more of the support systems; lack of top management commitment; or lack of user training, education and understanding.

Let's assume the bills of material are incorrect. If items are missing, the initial parts explosion will not see the need for these parts in the required assemblies, and no buy orders will be generated for them—resulting in permanent shortages and manufacturing bottlenecks. The same thing happens if the parts are present, but the quantities per assembly are incorrect.

If the routings don't reflect the way a part is actually built, the time needed to complete a work order will be over- or understated. If the open purchase order file contains old purchase orders for parts that will never be delivered but, due to everyday pressures, have not been deleted, this will reduce the quantities MRP tells you to buy. The programs don't know that these are bad P.O.s. It just looks at them as another supply factor and reduces the quantity to buy.

One of the toughest systems to keep honest is the work-in-process. Yet, if the WIP files show parts that are not really there, MRP will tell you to build less than you really need. Conversely, if you have jobs on the floor that have not been recorded in the WIP files, MRP will tell you to open more work orders, resulting in excess inventory.

Politics can enter into the process as well. Marketing tends to adjust forecasts to please top management. Where they are not responsible for the level of goods in finished inventory, they will tend to order more than required to provide a higher level of customer service.

Underestimating sales means disrupting the orderly manufacturing process when greater than anticipated orders are booked.

What this all means is that each area or department in the manufacturing process responsible for one or more of the data files in the support systems that MRP uses for its calculations has an opportunity to make or break the system. An unusually high degree of cooperation is therefore required on the part of all participants. Further, it implies the presence of good manual systems that establish the disciplines required to maintain the integrity of the data base.

Lack of top management commitment is a factor that is sometimes difficult to pinpoint; it shows up mostly in matters of priority. To implement MRP may require, for example, an extensive reworking of the product structures and bills of material, and rechecking them for accuracy. Even though management has asked for MRP to be implemented, requests for additional personnel required to do this kind of groundwork may be turned down. People assigned to these tasks will be interrupted for other work.

At the end of the quarter, orderly, disciplined systems will be abandoned to meet shipment goals. Movement of goods into and out of inventory (mid-night requisitions) will not be recorded, and the paperwork trail left behind will be keyed in late, if at all. At that point, the data base no longer reflects reality and the outputs of MRP are meaningless. It takes a very high level of awareness and commitment on management's part to defer shipments in favor of maintaining data integrity, but this is exactly what must be done.

Too often, the cost of implementing MRP is presented to top management in terms of the additional hardware and software to be purchased, and perhaps the MIS department's additional personnel requirement. The

^

Delivery schedule from open p.o. file
Time period

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| A | 20 | 20 | 20 | 20 | 20 | 20 |
| B | 100 | 100 | 100 | 100 | 100 | 100 |
| C | 50 | 50 | 50 | 50 | 50 | 50 |
| D | 50 | 0 | 0 | 0 | 0 | 0 |
| S | 10 | 20 | 20 | 20 | 20 | 20 |
| I | 20 | 20 | 20 | 20 | 0 | 0 |

**Figure 3. Delivery schedule from open P.O. file**

^

| Item | Quantity on-hand |
|---|---|
| A | 50 |
| B | 20 |
| C | 100 |
| D | 30 |
| H | 45 |
| I | 30 |

**Figure 4. On-hand quantities**

Time period

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| A | -50 | -30 | | | | |
| B | 80 | 300 | | | | |
| C | -110 | -80 | | | | |
| D | 100 | 420 | 60 | 60 | | |
| H | -55 | -55 | -55 | -55 | | |
| I | -50 | -20 | 0 | 20 | | |

^

**Figure 5. Number of each part short**

| Item | Time period | | | | | |
|---|---|---|---|---|---|---|
| | -2 | -1 | 1 | 2 | 3 | 4 |
| B | | 80 | 300 | | | |
| D | | 100 | 420 | 60 | 60 | |
| I | | | | 20 | | |

**Figure 6. Negative time periods**

investment is much greater than this. It requires additional effort in every area of the company, meaning dollars, time and people. Seldom are these ramifications spelled out. Those in favor of MRP naturally tend to minimize its cost and impact. Those responsible for support systems hate to admit that their data needs extensive correction. The more surprises sprung on management as the MRP drama unfolds, the less enthusiastic the managers are about doing it. It begins to look like a bottomless hole, which is exactly the opposite of the desired effect.

The MRP process is complicated at best. To the users who provide the support for a successful implementation, MRP usually appears as something that is done "to them" rather than "for them" or "by them." Yet this does not need to be the case. At one site, seemingly endless resistance faded away as a series of seminars took place, outlining the fundamentals of MRP and how each person's contribution helped maintain the whole system. People began asking to be sent to these classes. The frustration in the MIS department at trying to force people into cooperating was replaced by demands from the users for more service and reports and a feeling on their part of "we'll take it from here."

The following sample list of vendors have MRP packages for minicomputers, with at least 50 packages installed: Arista Manufacturing Systems, Winston-Salem, NC; ASK Computer Systems, Los Altos, CA; Computer Methods, Cupertino, CA; Interactive, Inc., San Diego, CA; Mandate Corp., Cleveland, OH; Manufacturing Resources Management, Milwaukee, WI; NCA Corp., Sunnyvale, CA; Software International, Andover, MA; Software Management Systems, Denver, CO; and Systems Management, Des Plaines, IL. □

# UNDERSTANDING HEXADECIMAL NUMBERS

by Jim Tallman

When using computers, we often encounter hexadecimal numbers. Modern computers operate on binary numbers because they are implemented using electrical components that can be in only one of two possible states. This is called binary logic. These two states are sometimes represented as high and low, as ON or OFF, or as 1 and 0. Any two unambiguous terms would do. All of the computer's internal decision-making and computation use this binary logic.

If all decisions and numbers were limited to one of these two choices, understanding the computer's internal representations would be easier. But it is not. These two binary states are expanded and used to represent a unique location in the address space of 65384 or one of a group of positive integers from 0 to 255. In fact, all internal floating point calculations are done using binary. To understand how this one simple choice between only two selections can be extended so usefully, let's begin by analyzing the more familiar number system that we use every decimal. Understanding the details of how decimal works will help in the explanation of hex. We will limit our discussion to positive integers to simplify the explanation.

Decimal numbers are a series of digits utilizing the characters 0, 1, 2,...8, 9. Each of the characters (numbers) has a unique value. But their position also reveals some information. We will examine in detail what this positional information is.

In grammar school, we learned the concept of place value. We know that 4682 represents 4 thousands, 6 hundreds, 8 tens and 2 units. This can be shown more mathematically as:

$$4682 = 4 \times 1000 + 6 \times 100 + 8 \times 10 + 2 \times 1$$

This raises the interesting question of why all the multipliers are growing by adding a 0 to each one. To help clarify this change, the mathematical representation is shown:

$$4682 = 4 \times 10*10*10 + 6 \times 10*10 + 8 \times 10 + 2 \times 1$$

$$4682 = 4 \times 10^3 + 6 \times 10^2 + 8 \times 10^1 + 2 \times 10^0$$

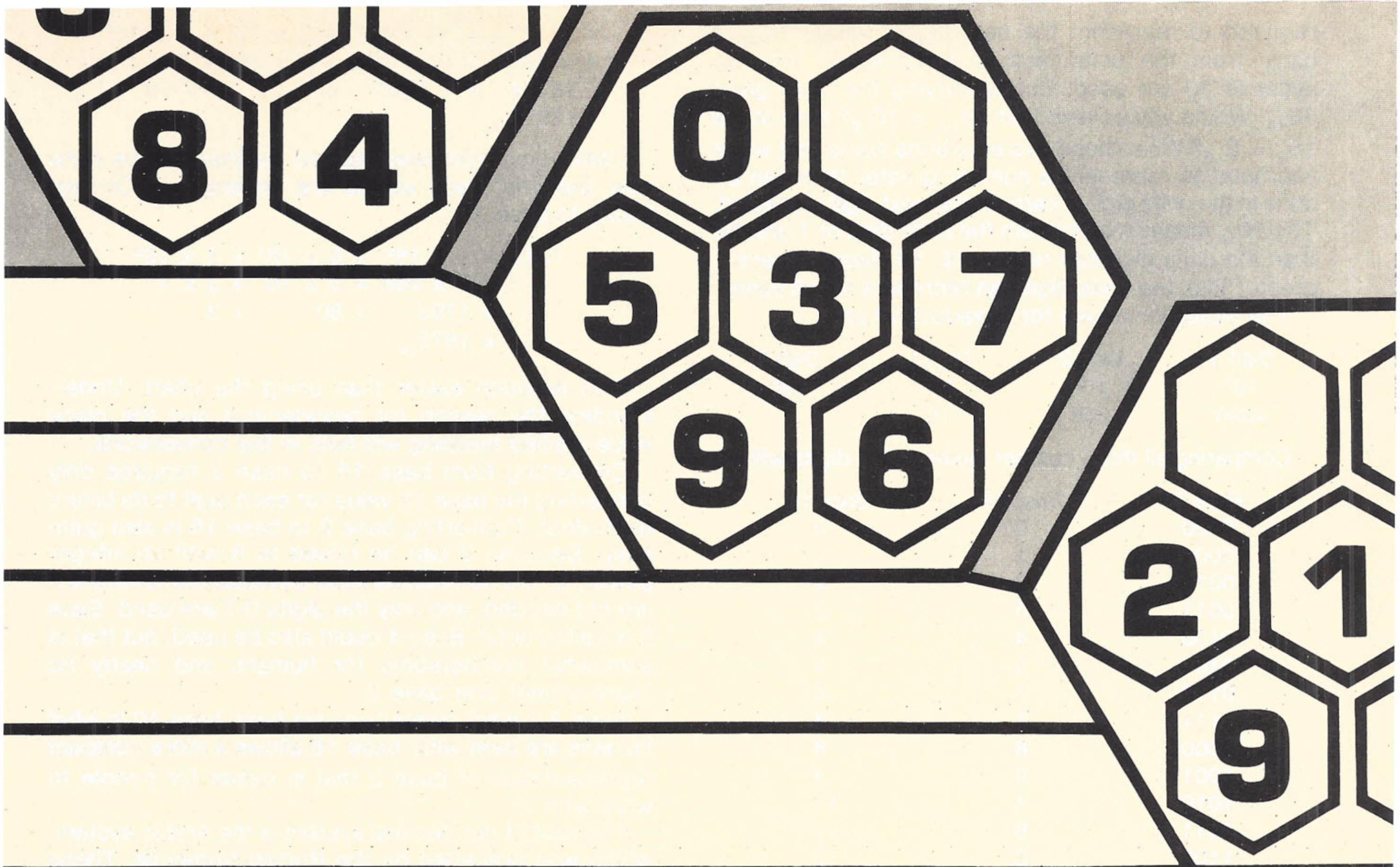
It can be shown that $10^0 = 1$. In fact, anything raised to the 0 power is 1.

From the above representation of 4682, we can see that each multiplier is a power of 10, and as digits are added to the left, the multiplier is multiplied by 10 again. Said another way, the base (10) is raised to one more power. We call the number that is being raised the base. Therefore, the decimal number system is also called the base 10 system.

Ten digits are needed in the base 10 system. To represent a quantity between zero (0) and nine (9) takes one position, the unity position, using 0...9. To represent a quantity less than the base, a single digit will do. But to represent the next higher quantity, we generate a carry (put a 1 in the next left position) and a 0 in the right position. In decimal, we call it ten. We likewise do this with all positions when we go beyond the representation capability of the digits in use.

We call the period (.) to the right of the integer (sometimes implied and omitted) a decimal point. In general, it is called a radix point and in base 2, it would be properly called a binary point.

When using different number systems, it is necessary to add an indication of what base is utilized. This is usually done with either a subscript or an added symbol. In the academic world and in textbooks, the




subscript is dominant, but assemblers do not provide for subscripts, so prefixes or suffixes dominate. An example would be 4682 @10, 4682D, or %4682.

**Enclosed Conversion Chart**

| Digit 3 | | Digit 2 | | Digit 1 | | Digit 0 | |
|---|---|---|---|---|---|---|---|
| **Hex** | **Decimal** | **Hex** | **Decimal** | **Hex** | **Decimal** | **Hex** | **Decimal** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 4,096 | 1 | 256 | 1 | 16 | 1 | 1 |
| 2 | 8,192 | 2 | 512 | 2 | 32 | 2 | 2 |
| 3 | 12,288 | 3 | 768 | 3 | 48 | 3 | 3 |
| 4 | 16,384 | 4 | 1,024 | 4 | 64 | 4 | 4 |
| 5 | 20,480 | 5 | 1,280 | 5 | 80 | 5 | 5 |
| 6 | 24,576 | 6 | 1,536 | 6 | 96 | 6 | 6 |
| 7 | 28,672 | 7 | 1,792 | 7 | 112 | 7 | 7 |
| 8 | 32,768 | 8 | 2,048 | 8 | 128 | 8 | 8 |
| 9 | 36,864 | 9 | 2,304 | 9 | 144 | 9 | 9 |
| A | 40,960 | A | 2,560 | A | 160 | A | 10 |
| B | 45,056 | B | 2,816 | B | 176 | B | 11 |
| C | 49,152 | C | 3,072 | C | 192 | C | 12 |
| D | 53,248 | D | 3,328 | D | 208 | D | 13 |
| E | 57,344 | E | 8,584 | E | 224 | E | 14 |
| F | 61,440 | F | 3,840 | F | 240 | F | 15 |

EOI ENCOUNTERED.

Usually the number is assumed to be decimal if no prefix nor suffix is attached to indicate another base.

Now apply this notation and these ideas to the computer's number system, binary. The base is 2, so the number of digits needed is also two, 0 and 1. Now examine the base 10 value of the number 1011 @2 (this is base 2). Utilizing the idea of bases and exponents raising the base to powers yields the mathematical representation:

$$
\begin{aligned}
1011\ @2 &= 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 \\
&= 1 \times 8 \ + 0 \times 4 \ + 1 \times 2 \ + 1 \times 1 \\
&= \quad 8 + \quad 0 + \quad 2 + \quad 1 \\
&= 11_{10}
\end{aligned}
$$

We would be very confused without the subscripts because the equation would read 1101 = 11. To be clear, we must put $1101_2 = 11_{10}$. This example shows that in binary, each position to the left doubles in multiplier value analogously to the way that in decimal, each position to the left multiplies by 10 in multiplier value. In both cases, the base is raised to another power in each position to the left.

As indicated earlier, computers deal exclusively in base 2. But this isn't so easy for people to deal with. A third base, 16, somewhat bridges the gap for us humans.

If we consider a group of four binary digits as a single hexadecimal digit, a carryout is needed when we exceeded $15_{10}$, $1111_2$. Examine a four digit base 2 number, $111_2$. This is:

$$
\begin{aligned}
&= 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 \\
&= 8 \quad + \ 4 \quad + \ 2 \quad + 1 \\
&= 15_{10}
\end{aligned}
$$

These four binary digits could be represented in a single digit if we invented a number system with 16 symbols per digit. This can be done with hexadecimal or base 16. This requires 16 characters for the values 0 to 15 that all occupy the units position. When it's

required to represent the next higher value, $16_{10}$, a carry from the units digit is required so the two symbols 10 are used. But specifying the base gives $10_{16}$. Would you believe that $16_{10} = 10_{16}$? How about $10_2 = 2_{10}$? What those two equations say is that when you need to represent a number greater than can be done in the units digit, a carry to the next digit is needed. The $10_{16}$ means a carry from the units digit or 1 greater than the units digit can represent. 10 always means 1 greater than the units digit can represent for all bases.

The multiplier values for hexadecimal are:

| Digit 3 | Digit 2 | Digit 1 | Digit 0 |
|---|---|---|---|
| $16^3$ | $16^2$ | $16^1$ | $16^0$ |
| 4096 | 256 | 16 | 1 |

Comparing all three number systems the digits will be:

| Base 2 | Base 16 | Base 10 |
|---|---|---|
| 0000 | 0 | 0 |
| 0001 | 1 | 1 |
| 0010 | 2 | 2 |
| 0011 | 3 | 3 |
| 0100 | 4 | 4 |
| 0101 | 5 | 5 |
| 0110 | 6 | 6 |
| 0111 | 7 | 7 |
| 1000 | 8 | 8 |
| 1001 | 9 | 9 |
| 1010 | A | 10 |
| 1011 | B | 11 |
| 1100 | C | 12 |
| 1101 | D | 13 |
| 1110 | E | 14 |
| 1111 | F | 15 |

To represent 0000 to 1001 in base 16, the same symbols as decimal are used. But some new ones are needed for the binary patterns 1010 to 1111. To fill this need, the first five letters of the alphabet are borrowed. Any five symbols would do, but it would be nice to have some found in character generators, typewriters, printers and that people know how to draw.

Using the above idea, evaluate what $4A23_{16}$ means in base 10.

$$\begin{array}{lllllll} 4 \times 16^3 & + & A \times 16^2 & + & 2 \times 16^1 & + & 3 \times 16^0 \\ 4 \times 4096 & + & 10 \times 256 & + & 2 \times 16 & + & 3 \times 1 \\ 16384 & + & 2560 & + & 32 & + & 3 \\ 18979_{10} & & & & & & \end{array}$$

Conversion from one base to another can be done now that the place values are understood. Convert $753_{16}$ to base 10.

$$\begin{aligned} 753_{16} &= 7 \times 16^2 + 5 \times 16^1 + 3 \times 16^0 \\ &= 7 \times 256 + 5 \times 16 + 3 \times 1 \\ &= 1792 + 80 + 3 \\ &= 1875_{10} \end{aligned}$$

This is much easier than using the chart. Understanding the reason for hexadecimal and the place value implied meaning will help in the conversions.

Converting from base 16 to base 2 requires only converting the base 16 value for each digit to its binary equivalent. Converting base 2 to base 16 is also quite easy. Because 2 can be raised to 8 with an integer power, 3, it is sometimes used because the letters A-F are not needed, and only the digits 0-7 are used. Base 8 is called octal. Base 4 could also be used, but that is somewhat cumbersome for humans and nearly no improvement over base 2.

Base 2 is what computers use best; base 10 is what humans are best with; base 16 allows a more compact representation of base 2 that is easier for people to work with.

The root of our decimal system is the Arabic system, which was preceded by the Roman Numerals. These sufficed for counting, addition, and subtraction. When it came to multiplication, though, this system was inadequate. It was replaced by the Arabic system that is in use now.

It has been suggested that base 10 is obsolete in this computer age, and just as we discarded Roman Numerals for the Arabic system, we should discard decimal for base 16. Just as we are making the gradual conversion to metric, someone has suggested abandoning decimal. We could talk to computers easier, but who is the master and who is the slave? Couldn't you just imagine learning multiplication tables all over again in base 16? Here is a test: What is A X F?□

BETA COMPUTER DEVICES

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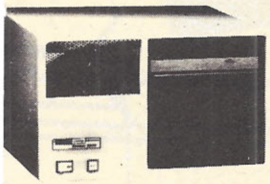

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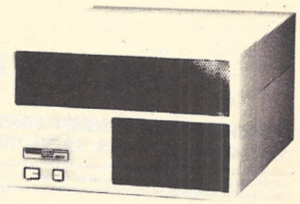
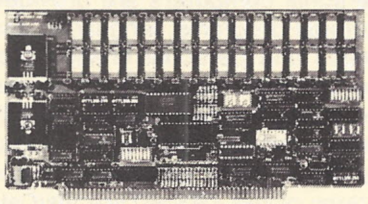
| | |
|---|---|
| 2812 CP/M, 2 Single Sided Floppies | $3775.00 |
| 2814 CP/M, 2 Double Sided Floppies | 4425.00 |
| 2819 CP/M, 1 10 MB Winchester & 1 Double Sided Floppy | 6675.00 |
| 2824 MP/M, 2 Double Sided Floppies | 5235.00 |
| 2829 MP/M, 1 10 MB Winchester & 1 Doubled Sided Floppy | 7500.00 |



Model 2819/29

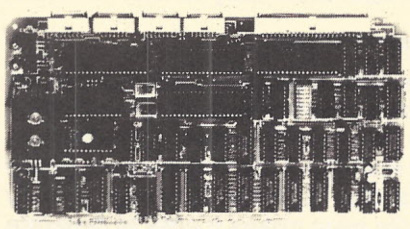
## S-100 PRODUCTS



**QUALITY RAM FROM SYSTEMS GROUP**

- Z-80 4MHZ operation with no wait states
- IEEE compatible timing - 200 NS 4116's
- Factory assembled, tested & burned in

| | |
|---|---|
| DMB6400 64K(Bank Select, shown) | $ 740.00 |
| DM6400 64K | 540.00 |
| DM4800 48K | 510.00 |
| DM3200 32K | 475.00 |



**CONFIGURE A COMPLETE S-100 SYSTEM WITH 2nd GENERATION* PRODUCTS FROM SYSTEMS GROUP.**

- CPC 2810 (shown) Z-80A processor board (4MHZ) with 4 serial & 2 parallel ports....$369.00
- CPC2813 - same as CPC2810 but 2 serial ports only....$345.00
- FDC2801/8 - 8" floppy disk controller board, up to 4 single/double sided drives, single or double density....$349.00
- INO-2804 - 4 channel serial I/O...... 329.00
- CRA-100 - Cromix* adaptor board.. 55.00

*CALL US FOR OUR MOST CURRENT PRICES!*

*2nd Generation is a trademark of Measurement Systems and Controls, Inc. Cromix is a trademark of Cromemco, Inc. CP/M and MP/M are trademarks of Digital Research. OASIS is a trademark of Phase One Systems.

## PAPER TIGER PRINTERS

| | |
|---|---|
| IDS 460G 9x9 Dot Matrix Printer | $890.00 |
| IDS 560G Wide Carriage Printer | 1099.00 |

### TERMINALS

| | |
|---|---|
| ADDS Viewpoint | $569.00 |
| TeleVideo 910 | 579.00 |
| TeleVideo 912C | 679.00 |
| TeleVideo 920C | 729.00 |
| TeleVideo 950 | 929.00 |

### 8" DISK DRIVES

| | |
|---|---|
| Shugart 801R | $399.00 |
| NEC FD1160 (double sided) | 525.00 |

### DYNAMIC RAMS

| | |
|---|---|
| 4116 (200ns) .......... set of 8 | $24.00 |
| 4164 (64Kx1) | $18.00 |

### wabash

**8" or 5¼" flexible diskettes** certified 100% error free with manufacturer's 5-year limited warranty on all 8" media. Soft-sectored in boxes of 10. 5¼" available in 10-sector.

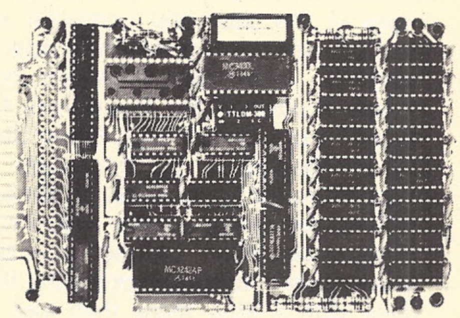
*(Add $3.00 for plastic library cases)*

| | |
|---|---|
| 8" single sided, single density | $27.50 |
| 8" single sided, double density | 35.50 |
| 8" double sided, double density | 45.50 |
| 5¼" single sided, single density | 27.50 |
| 5¼" single sided, double density | 29.50 |

**TERMS:** Minimum order $15.00. Minimum shipping and handling $3.00. Calif. residents add 6% sales tax. Cash, checks, Mastercard, Visa and purchase orders from qualified firms are accepted. (Please allow two weeks for personal checks to clear before shipment.) Product availability and pricing subject to change without notice.

**INTERNATIONAL ORDERS:** *Add 15% to purchase price for all orders. Minimum shipping charge is $20.00. Orders with insufficient funds will be delayed. Excess funds will be returned with your order. All prices are U.S. only.*

## 6502 PRODUCTS



6502DM

**BETA 32K BYTE EXPANDABLE RAM FOR 6502 AND 6800 SYSTEMS**

**AIM 65 KIM SYM PET S44-BUS**

- Plug compatible with the AIM-65/SYM expansion connector by using a right angle connector (supplied).
- Memory board edge connector plugs into the 6800 S44 bus.
- Connects to PET using an adaptor cable.
- Uses +5V only, supplied from the host computer.
- Full documentation. Assembled and tested boards are guaranteed for one full year. Purchase price is fully refundable if board is returned undamaged within 14 days.

| | |
|---|---|
| **Assembled** with 32K RAM | $349.00 |
| **& Tested** with 16K RAM | 329.00 |
| Bare board, manual & 6 hard-to-get parts. | 99.00 |
| PET interface kit. Connects the 32K RAM board to a 4K or 8K PET | $ 69.00 |

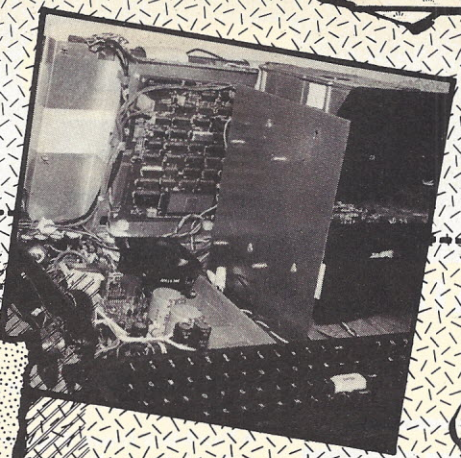
**AIM Professional Enclosure...$175.00**

BETA COMPUTER DEVICES
1230 W.COLLINS AVE.
ORANGE, CA 92668
(714) 633-7280

master charge VISA

# WHERE DOES THE TRS-80 GO FROM HERE?

by Terry Benson



Following the success of its TRS-80 model I, Radio Shack, Fort Worth, TX, introduced the model III, ensuring the company's position as the major contender for top sales in the desk top computer industry. With this success and the fact that the model I is now essentially obsolete, other companies are looking for ways to create a position for themselves in this high-volume market. Let's review what Radio Shack offers, as well as enhancements by third-party manufacturers to support model I and model III owners.

With well over a quarter-million systems in the field, there is significant interest from both manufacturers and software houses in providing the owners of these units with a little more than just the basic system. Naturally, Radio Shack is offering much of the add-on equipment and software that make the systems so useful; but there are a host of other companies doing the same.

Let's start with some of the more recent peripheral offerings from Radio Shack, confining the discussion to the models I and III. In order to support the expanding use of remote computing services like Arcnet and Videotex, Radio Shack has introduced a modem ($199) that is not only RS-232 compatible, but also is cleverly supported through the model I cassette port (but it requires some special cassette communication software). For graphic enthusiasts, there's a new digitizer ($449) that interfaces to any RS-232 port and can assist with graphic document generation. Another graphic tool (also RS-232 compatible) is the company's multipen plotter ($1,995) with supporting software package. For the energy-conscious, the Plug 'N Power controller ($40) enables the computer to control remote AC power modules (sold separately).

Radio Shack is making an all-out effort to support the small business with a variety of economically-priced peripheral products. For some time, the company has offered an expansion interface for the model I, with or without memory. Add-on diskette drives have been available for both the model I and model III; a wide selection of printers rounds out the peripheral product line.

The popularity of this hardware has only been possible due to an assortment of supporting software packages. The users of these personal computers are provided with educational and tutorial programs, languages and utility packages, business and personal finance programs, and games. New programs are being introduced continually and older programs are being upgraded with new features to better support business applications.

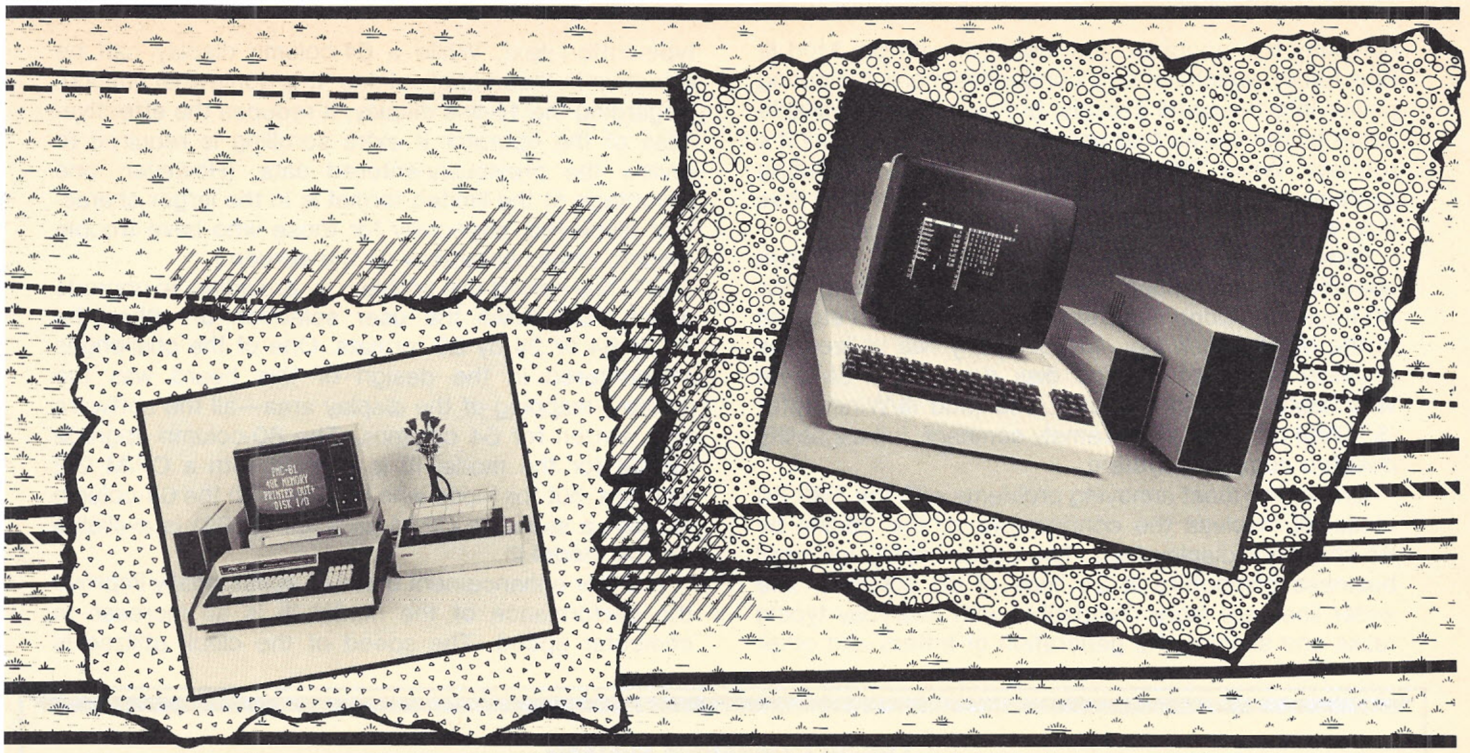
Probably two of the most useful programs for the small business applications of the TRS-80 are VisiCalc (manufactured by Personal Software) and Scripsit, both directly available from Radio Shack. VisiCalc is considered by many to be the foremost management planning program, with most other similar products comparing their features to those of VisiCalc. Scripsit and its expanded edition, Super Scripsit, offer sophisticated word processing capabilities with convenient operator commands that make them easy to learn and use.

**Dictionary has extra features**

The recently-announced Scripsit Dictionary provides the user with automatic proofreading for all document generation. With the data base management packages, Profile and Profile III Plus, the creation of various types of records and data files is made possible virtually without training. Profile even makes it easy to generate mailing lists that can be merged with a letter generated in Scripsit for a personalized look.

There is an approach to the model I software support that increases its repertoire substantially. The only way that could happen is if it supported CP/M—which is exactly what's been done. The challenge is to allow CP/M to operate in the TRS-80 hardware environment, even though the two are not compatible.

There are several approaches to the problem, but the technique is essentially the same for all model I conversions: provide a piggyback adapter that plugs into an existing socket with the necessary hardware added to the piggyback board. But there are software changes as well. One subtle bottleneck is the 64-column display that is memory-mapped and not easily converted to 80 columns—so the easy way out is to change the CP/M drivers.



Two companies are offering the CP/M upgrade packages for the model I. Omikron Systems, Berkeley, CA, has been producing its Mapper I ($239) for almost two years (IA Nov 80). Over 2,000 units are installed, providing CP/M 2.2 operation on 5¼-in. disks. The company even produces an 8-in. disk upgrade called the Mapper II. In the works is a similar conversion for the model III called Mapper III. All versions add the ability to use CP/M software with extra enhancements by using the diskette provided with each adapter.

The second CP/M enhancement comes from F.E.C. Ltd., Woburn, MA. The Freedom Option ($199) uses the piggyback approach and allows the use of CP/M software, as with the Omikron modification. F.E.C. also offers a more complete add-in that provides the CP/M capability along with 16K bytes of RAM (for a total of 64K) and a battery-backed clock ($490). The company claims everything is still fully TRS-80-functional, but can now operate with all of the CP/M software, too.

There are also significant advances in the area of hardware support. Usually, memory capacity in a system is one of the parameters evaluated when looking at system capability and relative cost. The model I was originally available with 4K bytes of user memory, but most people opted for the 16K version, if not the full-capacity 48K. Bank-switching techniques can even expand its size to a full 64K. The additional memory can be very convenient when operating on large data files, since it will minimize time-consuming access to the external storage devices.

Disk capacity is another very important consideration in choosing and operating a computer system. The minimum model III doesn't even include a disk drive, but it does include the not-very-practical cassette interface. Small business applications require at least one, if not two, disk drives. So Radio Shack and several other manufacturers offer add-in disk drives for the model III and even add-on disk drives for both models.

The model III can be purchased as a desktop business computer with two 5¼-in. disk drives, allowing up to 350K (306K usable) bytes of disk capacity. With two additional external double-density, 40-track drives, a total of about 700K bytes is available to the system software. This approach requires a total of four disk drives (two are external), but new controllers are now available from other suppliers, which allow 80 tracks on *each* side of the diskette, giving a total capacity of 700K bytes on *one* diskette.

Another peripheral that seems to be getting a lot of attention is the Winchester hard disk. As an add-on, the hard disk gives extended capacity of almost 5M bytes per drive but, due to the fact that it is not removable, it requires that data be backed up on floppy disks. The hard disk offers the model III owner a simple way of adding an enormous amount of storage, especially when compared to the 25 or so diskettes it replaces.

The enhancements and add-ons have been made available to the TRS-80 user from a number of different manufacturers like VR Data, Folcroft, PA, and Microcomputer Technology, Inc. (MTI), Santa Ana, CA. VR Data installs Tandon disk drives using metal straps, which allow the company to comply with FCC regulations regarding EMI radiation. In addition to the built-in drives, Disk III add-on drives are offered for either the model I or model III. The custom disk controller will support up to four drives of either 40 or 80 tracks, single or double sided. With a full complement of drives and either LDOS or a modified TRSDOS, nearly 2.8M bytes of on-line storage are available.

Like VR Data, MTI also provides an assortment of disk drives for either single or double density additions to the model III. In addition, MTI offers a 5M-byte Winchester ($2,799) as an external peripheral, with a similar product scheduled from VR Data. These disk add-ons make it cost-effective for the present TRS-80 owner to upgrade or expand his system to greater capacities than originally designed and also provide the higher performance dictated by his business growth. Besides the TRS-80 model III and its peripheral support, there have been other noteworthy approaches to the problem of providing a desktop computer for a small business.

Probably one of the most efficient packaging methods in terms of storage capacity is offered by MTI. The

company has upgraded the model III with the Mod III Plus family, which not only condenses more computing power into the same chassis, but also makes available some of the extras that usually go unnoticed until it's too late. While TRSDOS and other familiar operating systems will work with this family, MTI offers DOS Plus 3.3, which supports full-system disk capacity.

Disk storage capacity is one area that MTI has specifically addressed. In addition to making one 80-track, two-sided diskette with 700K bytes of storage in the bottom disk slot, the company has utilized the physical space of the top disk drive for a 5M-byte Winchester disk in one unit. The Mod III/Winchester ($5,399) provides an extremely compact, full-capability desktop computer system.

One of the most annoying problems with the TRS-80 model III involves the confinement of the 16-line by 64-character display field. The usual display for small business computers is 24 lines of 80 columns. The wider lines are more compatible with everyday typing tasks and simplify the generation of letters and other typewritten text. While a 64-column display can be effective in these applications, it is somewhat limiting. Regarding the 16-line display, it reduces the effectiveness of the operator if extra scrolling is required to review the previously-entered data. (However, one advantage of the limited format is in the larger characters displayed, especially for those who have trouble reading small characters on the screen.)

MTI has solved this problem by providing an upgrade board that allows the user selection of either the 16 by 64 or 24 by 80 formats. One of the challenges encountered in the design of this board was the memory-mapping of the display area—all the software was written for 64 columns. The 80-column upgrade ($849) for the model III is offered with a CP/M 2.2 diskette, but for those who can live with the 64-column display, a separate CP/M package ($599) is available for the model III.

Another enhancement that can substantially improve the performance of the model III is an increase in computer speed. The speed of the clock utilized is

**TRS-80 Compatible Systems**

| **Company** | Radio Shack | VR Data Corp. | MTI | LNW Research | Personal Micro Computers |
|---|---|---|---|---|---|
| **Address** | One Tandy Ctr.<br>Fort Worth<br>TX 76102 | 777 Henderson Blvd.<br>Folcroft<br>PA 19032 | 3304 W. MacArthur<br>Santa Ana<br>CA 92704 | 2620 "A" Walnut Ave.<br>Tustin<br>CA 92680 | 475 Ellis St.<br>Mountain View<br>CA 94043 |
| **Model** | TRS-80 model III | Model III | Mod III/280 | Team | PMC-81 |
| **Price** | $2,495 | $1,882 | $2,799 | $2,995 | $1,235 |
| **User RAM** | 48K | 48K | 48K | 96K | 48K |
| **Disk Drives** | 2 | 2 | 2 | 2 | opt |
| **Disk Storage** | 306K | 306K | 1.4M | 306K | n/a |
| **Max. Floppy Capacity** | 656K | 2.8M | 2.8M | 3.5M | 656K |
| **Fan** | no | no | opt | std | no |
| **Clock Speeds** | | | | | |
| **1.77 MHz** | | | | std | std |
| **2.0 MHz** | std | std | std | | |
| **4.0 MHz** | | | opt | std | |
| **12" Video Monitor** | std | std | std | std | opt |
| **Screen Formats** | | | | | |
| **16 x 64** | std | std | std | std | std |
| **16 x 32** | | | | std | |
| **24 x 80** | | | opt | std | |
| **24 x 40** | | | | std | |
| **Color** | no | no | no | yes | no |
| **Hi Res Graphics** | no | no | no | yes | no |
| **Keyboard Keys** | 65 | 65 | 65 | 75 | 72 |
| **Interfaces** | | | | | |
| **RS-232** | std | opt | opt | std | opt |
| **Cassette** | std | std | std | std | no |
| **Printer** | std | std | std | std | opt |
| **Operating Systems** | | | | | |
| **TRSDOS** | std | std | | | std |
| **DOS Plus** | | | std | opt | |
| **LDOS** | | opt | | | |
| **CP/M** | | | opt | opt | |
| **T8/OS** | | | opt | | |

n/a—not applicable  std—standard with the listed price  opt—available as an option from the same vendor

2.0 MHz but with appropriate hardware changes, the Z80 microprocessor at the heart of the system will actually run at least twice that speed. Upgrading the system to operate at 4.0 MHz will double the operating speed and increase the overall software throughput. Merely changing the clock frequency will not accomplish the desired results—there are other considerations. MTI has modified the operating system to allow the clock to be switched between frequencies to accommodate both the TRS-80 operating system and the company's version of CP/M.

MTI has also reduced EMI radiation by adding internal shielding with metal brackets for the disk drives, further increasing the system reliability and software integrity. Another reliability problem with most computer systems is the operating temperature—especially the temperature *inside* the system. One problem demonstrated with the present model III is its susceptibility to high temperatures. MTI offers an optional cooling system for inclusion in the Mod III Plus family and also as a mod kit for existing model IIIs. The fan can be particularly useful in extended operating conditions where disk reliability may have been a problem in the past.

A different approach to the issue of model I compatibility is offered by Personal Micro Computers (Mountain View, CA). Its new PMC-81 is more suitable for business applications than the original MPC-80. The more recent edition sports an essential diskette controller and built-in power supply. The unit provides a few more keyboard features with four user-programmable function keys and a 15-key keypad.

The PMC-81 is available in a modular configuration like the TRS-80 model I, except it lacks a built-in cassette interface. The expansion unit allows the use of S-100 boards, and the printer interface adapter (PIF-40) provides hardware compatibility with the 40-pin model I bus. Since the unit is fully model I-compatible, the options and peripherals can be utilized to expand the system's capabilities.

### Strong system software

Model I level II software compatibility is provided, but a change may be required in any TRSDOS software that operates the RS-232 port. There are several operating systems that are supported, but the company is promoting DOS Plus. And with the addition of one of the CP/M enhancement packages, the system software capabilities are almost unlimited.

LNW Research Corp., Tustin, CA, has taken an entirely different approach to supporting the multitude of available software. The hardware has not been modified, and the unit does not look like the TRS-80. The Team computer, however, is as compatible as possible with the TRS-80. The company claims 100% compatibility with the TRS-80 model I hardware and software. In addition, the added features make it more than just another model I.

First of all, the system's Z80A clock has been converted to 4 MHz, with manual or automatic selection. The original speed of the model I was 1.77 MHz, but even at 4 MHz, no RAM wait states are required. As with the TRS-80, a 12K Microsoft Basic interpreter in ROM is included, which is bank-selectable to permit overlaying into part of the RAM address space (which has been expanded to 96K). In addition to the expanded

RAM, there is a 1K block of video RAM, plus a *separate* 16K block of high-resolution graphics RAM that supports various black and white or color graphic applications.

The display options have also been expanded to provide the more common 24 by 80 format, but allow the operator to select 24 by 40, along with the TRS-80 standards of 16 by 64 and 16 by 32—all in upper and lower case. The reduced line sizes are available, so that a standard TV interface can be accommodated. The 75-key keyboard has been expanded to include a numeric keypad plus shift-lock; caps-lock keys and cursor control keys are all grouped together.

### Compact configuration

The all-metal chassis houses all of the electronics, a keyboard and a fan, but the remainder of the system can be modularized as the user desires. The built-in floppy disk controller offers the ability to support 5¼-in. or 8-in. drives, single or double density, and single double sided—in any combination—to a maximum of four single-sided or three double-sided drives. If all are 8-in. drives, up to 3.5M bytes of storage can be accessed at one time.

In addition to the TRS-80 software compatibility, the Team offers CP/M compatibility *built-in* as a standard feature. So, all the software we've mentioned, at least for the model I, can operate on this system. But LNW Research has rewritten all of the drivers and is customizing the available operating systems for the Team. While the system will support CP/M, the operating system is an option, since the company makes Cromemco's T8-OS available as well.

If you're still in a dilemma about the TRS-80, there's no wonder. There are so many choices and options. What's the best system for your particular situation? It's hard to give a recommendation. The accompanying comparison table summarizes some of the available systems—but it can't show everything.

Other considerations include follow-on support—expansion hardware, useful software or field service. Radio Shack has 180 computer centers to help choose the proper system and peripherals for business applications. Each store boasts a staff of trained technicians to repair any system problems. Training sessions are also available for the novice computer user.

If the user does choose a TRS-80 model III from Radio Shack, expect it to be well-supported and, as we've shown, modularly expanded to meet your needs. VR Data and MTI offer the TRS-80 model III, but with more integral storage capacity, thereby giving the better of two worlds—Radio Shack hardware, but in a more compact configuration. For those who care less about the hardware itself than computing power, the options from LNW and Personal Micro Computers should be considered. If you wish to be able to use CP/M software (which isn't a bad idea), any of the choices will do, but the user needs to decide whether he wants to add someone else's mod kit to the chosen system.

The model III is destined to be around in one configuration or another for some time. Continuing support both on the hardware side and, especially, on the software side, will help to prolong its life. One of these economical systems or additions should ensure a productive desktop computer that can keep up with the growth of your business. □

Software Review

# Documate/Plus for WordStar

## Table of Contents and Index Generation

by Alan R. Miller

There was a time when computers were used primarily for computing. Now it seems that computers are frequently used for the creation and alteration of documents such as letters, reports and book manuscripts. This is especially so for microcomputers. Documents are created and altered with a computer program called an editor or a text processor. Some of these programs are rather primitive, while others, such as WordStar (IA Mar 81), Magic Wand (IA Jan 81) and Benchmark are much more sophisticated.

There are typically two steps in the preparation of a document. The first step is to create a text file with an editor. The second step is to format the resulting text file. Magic Wand contains both an editor and a separate formatter. On the other hand, a separate editor is required for document creation when text formatters such as Tex (IA May 79) and Textwriter (IA June 80) are used. WordStar represents a third approach. A document is automatically formatted right on the video screen as it is being typed. Thus the user always sees the document in its final form.

WordStar by MicroPro (San Rafael, CA) is my choice for the creation of both documents and computer source programs. There are, however, a few shortcomings to this word processor. Other software organizations have addressed these problems by offering auxiliary programs.

For example, Spellguard (IA June 81) can be used to locate and mark misspelled words in a text file. The new version 2 has been improved in two major respects. The 20,000-word dictionary has been compressed from about 150,000 bytes to about 50,000 bytes. Thus it can now be stored on a single-density 8-in. diskette or a 5-in. double-density diskette. A second feature of the new Spellguard is that misspelled dictionary words, inadvertently added by the user, can be easily removed.

It is frequently desirable to include a table of contents and an index when reports, proposals and book manuscripts are prepared. While several commercially available text formatters have provisions for generating these two items, WordStar does not. Orthocode Corp., Albany, CA has solved this problem with a program called Documate/Plus. This program can generate a table of contents and an index from a document prepared with WordStar.

Like Spellguard, Documate/Plus is an entirely separate program from WordStar. Thus it might be possible to use it in conjunction with other word processors. The key to such compatibility is the format of the Documate commands. Each command begins with three periods. Since WordStar ignores lines beginning with two periods, the Documate commands are invisible to WordStar.

Entries for the table of contents are designated by a T command placed on the line preceding the actual entry. For example, the two lines:

```
...T
INTRODUCTION
```

will generate a table-of-contents entry containing the line INTRODUCTION. The page number will be given too. Notice that the heading "INTRODUCTION" is only typed once. Secondary levels of the table of contents, which are indented from the main levels, are indicated with the "T2" command. For example:

```
...T2
Pascal SIN and COS functions
```

and

```
...T2
Other Built-in Functions
```

will produce indented entries under the previous main heading. Additional sub-levels are designated by the commands T3, T4, etc.

The format of the table of contents can be controlled by the user. For example, the width of the table can be selected and the page numbers for each entry can be made to appear on either the left or right side of the table. Three of the possible formats are shown in figures 1, 2 and 3. The first example uses the default settings; the page numbers appear on the left side of the table. The second example uses a width that is narrower than several of the entries. In this case, the page numbers are on the right side of the table, but they are not aligned. The table width for the third example is greater than any of the entries. Consequently, the page numbers are properly lined up.

The creation of an index is a more sophisticated phase of Documate. Indexing by any method is a tedious task. It is not usually sufficient to simply select words

```
 1  EVALUATION OF A PASCAL COMPILER
 1     Introduction
 1     Precision and Range of Floating-Point Operations
 2     Pascal Program:  A Test of the Floating-Point Operations
 4     Pascal Sin and Cos Functions
 4     Pascal Program:  Testing the Sin Function
 6     Other Pascal Functions
 9     External Files
11     A Power-of-Ten Function
13     Pascal Program:  Calculating Powers of 10
16     Summary
```

**Figure 1. Table of Contents using default conditions**

```
EVALUATION OF A PASCAL COMPILER . . .   1
   Introduction . . . . . . . . . . .   1
   Precision and Range of Floating-Point Operations  1
   Pascal Program:  A Test of the Floating-Point Operations  2
   Pascal Sin and Cos Functions . . .   4
   Pascal Program:  Testing the Sin Function  4
   Other Pascal Functions . . . . . .   6
   External Files . . . . . . . . . .   9
   A Power-of-Ten Function . . . . . . 11
   Pascal Program:  Calculating Powers of 10 13
   Summary . . . . . . . . . . . . . . 16
```

**Figure 2. Table of Contents width set too small**

```
EVALUATION OF A PASCAL COMPILER . . . . . . . . . . . . .   1
   Introduction . . . . . . . . . . . . . . . . . . . . . .   1
   Precision and Range of Floating-Point Operations . . .   1
   Pascal Program:  A Test of the Floating-Point Operations   2
   Pascal Sin and Cos Functions . . . . . . . . . . . . .   4
   Pascal Program:  Testing the Sin Function . . . . . . .   4
   Other Pascal Functions . . . . . . . . . . . . . . . .   6
   External Files . . . . . . . . . . . . . . . . . . . .   9
   A Power-of-Ten Function . . . . . . . . . . . . . . . .  11
   Pascal Program:  Calculating Powers of 10 . . . . . . .  13
   Summary . . . . . . . . . . . . . . . . . . . . . . . .  16
```

**Figure 3. Table of Contents width correctly set**

and phrases from the text. General concepts, which may not appear literally, may also be needed. On the other hand, if a particular word is chosen for the index, it may not be desirable to reference each occurrence of this word. The Documate index commands are designed with these considerations in mind.

There are three different Documate index commands. Ordinary index entries are designated with the letter X. The command is placed close to the corresponding passage and contains the literal index entry. For example the command:

...X Least-squares curvefitting

will generate an index entry such as:

Least-squares curvefitting, 57

Notice that the entry is followed by a comma and the corresponding page number. If there are additional index references to the same string, the additional page numbers, separated by commas, will appear on the same line with a single entry. However, if duplicate entries are placed on the same page, the page number only appears once.

If a comma appears in the entry, the entry is printed on two lines. The first, or primary part appears on the first line. The secondary part, with its page reference, appears on the second line. If several entries have identical primary parts, the secondary parts will appear together. For example:

...X Quicksort, recursive
...X Quicksort, nonrecursive

might generate the entries:

Quicksort,
  nonrecursive, 32, 57
  recursive, 25, 46

If you want to include a comma in the middle of a primary reference, yet have the entry appear as on a single line, the entire entry is embedded in quotation marks. For example the entry:

...X "Underflow, floating-point"

will produce:

Underflow, floating-point, 76

If the entry itself is to be imbedded in quotation marks, double quotation marks are used.

Two other index commands are used for making reference entries; these are the R and the A commands. The R command generates the expression "see," while the A command produces a "see also" entry. For example if the line:

...A Quicksort, Sorting

were used with the above entries on sorting, the result might be:

Quicksort, see also Sorting
  nonrecursive, 32, 57
  recursive, 25, 46

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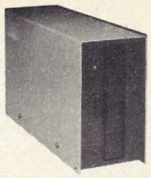

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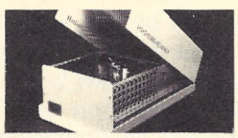

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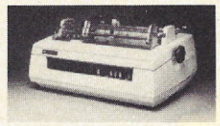

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# Create Chain Files Automatically

Chain files represent one of the most powerful operating tools available to microcomputer owners. Unfortunately, chaining is not used as widely as it could be, partly because the authors of disk operating systems sometimes have made the construction of chain files difficult for the average user to understand. Chain Writer is a Basic program that automatically builds chain files for TRS-80 model I operators who have Newdos 80, either versions 1.0 or 2.0. The program can also be used by model III owners who now have a very sophisticated operating system available to them in Newdos 80 2.0. It performs much the same task as CHAINBLD/BAS, supplied with Newdos 80 2.0, but the beginner should find it much easier to use and understand. Those with the original version of Newdos 80 who do not plan to upgrade it can construct chain files quickly and simply.

To get the most use out of the program, it's necessary to first define chain files and how they operate. Chaining is a flexible tool that allows a computer operator to pre-program a lengthy series of input records (or tasks) that can be strung together and called at any later time. Chain files can be used to load or run an entire series of programs, supply input to software or carry out several sequential jobs.

Though a chaining capability is implemented on a variety of microcomputers, TRS-80 model I users who have either Newdos 80, VTOS 4.0 or LDOS are probably the most numerous. The easiest way to begin to understand chaining is to look at what it can do. Consider this typical chain of commands:

```
LOWERCASE
ADR
BASIC 64000
RUN "INVENTRY/BAS"
```

When this chain file is called, the operating system will first load a lowercase drive, next a utility program called ADR/CMD, then go to Basic. Top of memory will have been set to 64000, and program INVENTRY/BAS will be run. These tasks will be accomplished without the operator needing to hit ENTER, or respond to a single prompt.

In the usual mode, a computer system looks to the keyboard for user input—a command to run a program, load a file, or some other information needed before the computer can go on with its work. When chaining is initiated, the system ignores the keyboard; instead it attempts to retrieve the data from the chain file called by the user. If the file has been set up properly, it will contain records that satisfy the input requirements. The chain of input can continue until the file ends and some operator input is required, or the computer detects an error that aborts the process.

A chain can consist of several different commands or a series of inputs designed to carry out a single task. For example, assume that a Newdos 80 1.0 operator intends to change the name and/or date of a number of diskettes. (This job can be done using PROT with Newdos 80 2.0). Granted, he already has the hexadecimal equivalents of the ASCII codes that will be substituted for the originals on the disk sectors. The most common place for the diskette name/date in TRSDOS-derived disk operating systems is track 17 decimal, sector one, relative byte D0 (hex). A chain could be built as follows to streamline this task:

```
SUPERZAP
DD
1,17,1
```

The operator could insert the target disk in Drive 1, call this chain file, then type in only MOD D0 and the new series of hex values. Other, more complex jobs can be cut down in size by similar means. A chain file may use only a few bytes of storage, but because the minimum allocation on a disk is one gran, a single chained set of commands could waste a full 1,280 bytes. To avoid this situation, programmers commonly string many chain sequences together. Each set of commands is called a section and treated as a separate chain of records by the system. It may be convenient to number sections, so that a given chain of records is called 1, the second in the chain file 2, and so forth. Most will find it easier to provide mnemonic names, such as FORMAT or INVENTORY.

These section names are called section IDs. To call a specific section under Newdos 80, simply type CHAIN, the chainfile's filename and the section ID. For example, if a user has a number of different chains in a file called INIT/JCL, but wishes to use the third one (named "3"), the command would be:

```
CHAIN INIT,3
```

If alpha character names are used instead of numbers, calling the desired chain would use the following syntax:

CHAIN INIT,INVENTORY

(Note: in Newdos 80 2.0, the command DO may be used instead of CHAIN. It has the advantage of being shorter to type in, and similar to the DO command of other microcomputer systems. In order to maintain compatibility with the earlier Newdos 80, I'll use only CHAIN in this article, but the two words are interchangeable in the latest versions.)

Chain files can call other chains, so after a variety of tasks are performed, the next record can be CHAIN INIT,5 or, from Basic: CMD"CHAIN INIT, INVENTORY".

Imaginative use of chain files can allow you to build a whole new set of DOS commands. For example, you may have several FORMAT or COPY commands that are used repeatedly, such as:

COPY 0 1,,NFMT,CBF,CWFO,USR

or

FORMAT :1 =35,,Y

The first is a Newdos 2.0 command to copy only user files (no System or Invisible files) from drive 0 to drive 1. No formatting of the target diskette will be done, copying will be by file, and the system will check with the operator for a yes/no decision before copying each file. The second example is a command to FORMAT a disk in drive 1 to 35 tracks (the drive has probably been specified to some other track count using PDRIVE).

Each of these can be incorporated into a chain file, using a simple mnemonic section ID, such as COPY USER, and FORMAT 35. We have built a personal chain file, named A/JCL, (the short name is intentional), which contains a variety of combinations of COPY and FORMAT commands, and appropriate ID names. In addition, the same file includes other section IDs, which are abbreviated versions of the same commands, so that we may type:

CHAIN A,F 1

or

CHAIN A,C 0 1

These initiate custom-designed FORMAT and COPY commands. It is not necessary to enter the chain commands both times. When section ID F 1 is called, the first record in that section is CHAIN A,FORMAT 1. This is an illustration of one chain file calling another.

Chain files can build other new DOS commands. NEWDOS 80 2.0 allows the user to change the specifications of any disk drive in the system from single and double density and back again, vary track counts and disk directory starting lumps, and so forth. The PDRIVE command performs the magic, and we won't go into details here. However, we have added onto my A/JCL chain file a series of section IDs and records that automatically change my drive specifications.

Though we currently operate almost exclusively under double density, we find a single density diskette to access from time to time. To switch drive 1 to single density operation, we type:

CHAIN A,1 SINGLE

To change it back:

CHAIN A, 1 DOUBLE

Here we've made liberal use of abbreviations, so that CHAIN A, 1 S or CHAIN A,1 D accomplishes the same thing. Newdos 80 2.0 users can have our new DOS commands as short as: DO A,1 S.

The drive specifications can get extremely complex, but changing from one to the other involves only a correctly constructed chain file.

Under Newdos 80 1.0 or 2.0, chain files are stored on disk as ASCII files, and thus can be constructed from Basic using ordinary disk I/O routines. In fact, the 2.0 version allows the user to make chain files from Scripsit, or some other word processing program. However, I've found that it is just as easy to use Chain Writer or a similar program.

With either version of Newdos 80, the system looks for various special characters in order to know just what is being asked of it. A CHR$(128) identifies the beginning of a section. In most cases, the very next record will be the section ID. Once the operating system has recognized CHR$(128), it assumes that all of the following records in the sequential chain file belong to the same section, until it comes across another CHR$(128) (marking the beginning of the next section), or an EOF marker.

Let's look at a simple chain sequence:

```
CHR$(128) + "1"
BASIC 64000
```

In chaining mode, the system will look at this string, find the CHR$(128), then accept the rest of the record, BASIC 64000, as a command. Other commands appended to the sequence will also be carried out, either until the next CHR$(128) is found, the file ends or one of the other three control characters is located. These allow messages to be imbedded in the chain, either for the operator or programmer's benefit.

CHR$(129) causes the rest of the record to be displayed; then the system pauses and waits for the operator to hit ENTER before continuing. A typical chaining sequence using this feature might be:

```
CHR$(128) + "1"
BASIC 64000
CHR$(129) + "HIT ENTER WHEN READY TO PLAY"
RUN "GRNDPRIX/BAS"
```

A message can be displayed and the chain continued without operator intervention by using CHR$(131). An example follows:

```
CHR$(18) + "1"
BASIC 64000
CHR$(131) + "GET READY TO PLAY!"
RUN "GRNDPRIX/BAS"
```

A final character string that can be imbedded in a chain file is CHR$(130). This marks what can be likened to Basic's REM. The message that follows in the record is neither displayed nor accepted as input. However, it remains as an element in the chain file to remind the programmer, or to explain an item in the file. How do you read such files to spot these remarks? Simply LIST the chain file from DOS command mode.

Those using Newdos 80 2.0 have one additional tool, CHNON. The syntax for this command is CHNON,N ,CHNON,Y and CHNON,D. These allow the operator to break in and add input in the middle of the chain file. Perhaps a series of commands will be carried out, then

the chain file would like to ask the operator which of several programs are to be run next. This feature is not implemented in Chain Writer, and is offered as a possible enhancement for advanced programmers. (Hint: CHNON can be imbedded in a chain file by adding a CHR$(133), plus either Y, N or D as desired.) Study the Newdos 80 2.0 documentation carefully for examples and an explanation of this capability.

Chain Writer can be used to automatically assemble these sequences with a minimum of fuss. It takes the operator through a number of input steps, and builds the file as directed, saving it to disk. Because Newdos 80's OPEN E feature is used to tack any later additions to the sequential file onto the end, one chain file can be expanded almost indefinitely to serve a variety of tasks.

The first step in using the program is to enter the file name of the chain file that is being created. Standard file-naming conventions should be used. The default file extension /JCL can be applied to help identify chain files in your disk directory. The name selected is stored in string variable A$ in line 180.

Next, input of the desired commands begins. A menu that displays the choices is printed to the screen. The user can enter ! to begin a new section, # to insert messages calling for a pause before chaining continues, a $ for messages without a pause, and % for REM-type notes. Many different chain sections can be entered in a given input section. The chain file will not be written to disk until the operator enters an E. An S may also be used to erase a series of entries and start over.

A typical session would look something like this sample run:

```
! INVENTORY
LCDVR
BASIC 64000
$ PLEASE HAVE DISK#2 READY
LOAD "INVENTORY/BAS"
# HIT ENTER WHEN DISK #2 INSERTED IN DRIVE 1
! COPY 0 TO 1
COPY :0 TO :1 00/00/00
E
```

This input would be accepted in a subroutine at lines 220-320. A FOR-NEXT loop from 1 to an arbitrary 30 asks for input of each record in a given chain. If you frequently write chain sequences longer than 30 steps, this number may be incremented, with corresponding changes made in the DIM statments on line 110.

The records in the file are stored in a string array, B$(n), and input continues until either 30 entries have been made, or an E or S input.

When a chain has been completed, control branches to the disk write portion of the program, beginning at line 340. The filename stored in A$ is either created (if none currently exists by that name) or reopened without disturbing the EOF marker, using OPEN E. Then a FOR-NEXT loop is begun. At various points in the loop, program lines look for one of the special characters, !, #, $, and %. If one is found in that element of B$(n), the proper CHR$(n) is inserted, and the record printed to the disk.

If none are found, the string is stored on the disk as is, and the loop counter incremented for the next pass-through.

To use the chain file that has been created, it is necessary only to follow the normal chaining syntax of Newdos 80. At any later time, Chain Writer can be run again, and the same file name specified. By using different section IDs for the new entries, the user can automatically tack them onto the end (through OPEN E) without having to rewrite the chain file or waste disk space with a second one. Once you begin applying chain files, you will constantly find new uses for them. As a final example, look at all the steps some double-density users need to go through in order to back up their system disks. It is necessary to format the disk in a separate operation (only with NEWDOS 80 1.0 and the patch DOUBLEZAP II) and carry out the COPY, then repair the BOOT sectors. This series can either be done one at a time, or completed with a few keystrokes through a chainfile:

```
DBLFMT 1, DISKNAME,06/07/82,,Y
COPY :0 TO :1,06/07/82,USD,UBB,NFMT
FIXBOOT 1
DIR :1 (S,I,A)
```

All of the above are not essential. But that chain file will format the disk, make a copy and repairs, then display the finished directory (System and invisible files both, along with granular allocation). Instead of performing these tasks manually, the user can take a break for five minutes and return refreshed. Chaining is one of the most sophisticated ways of breaking the ties that bind the computer user to the keyboard. □

**_Program on page 152_**

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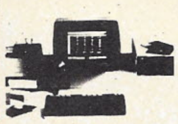

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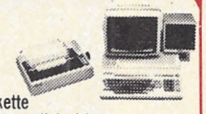

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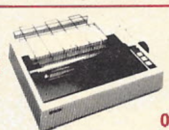

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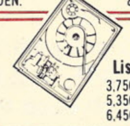

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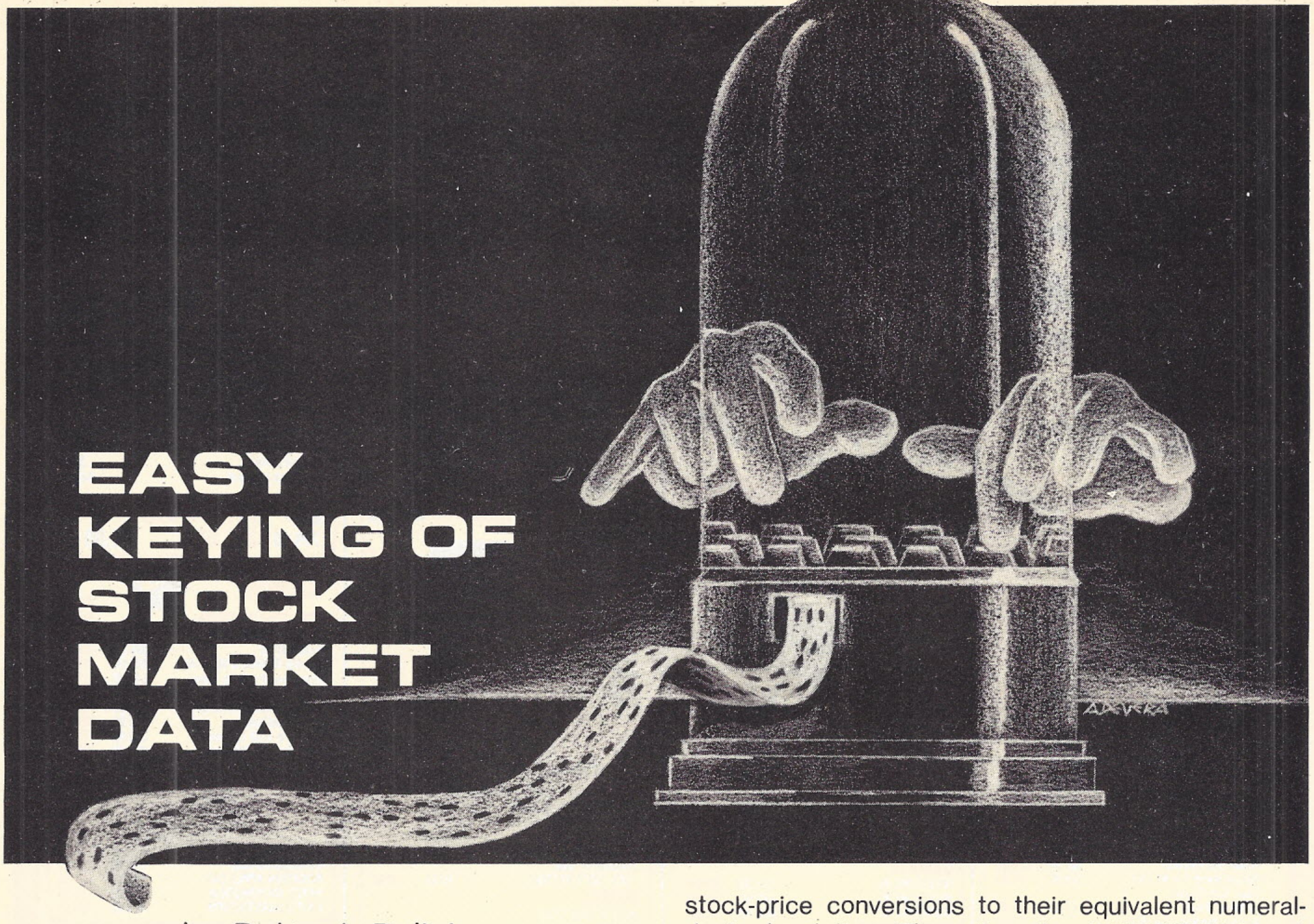

# EASY KEYING OF STOCK MARKET DATA

by Peter J. Polini

This program is geared to the stock market enthusiast who has no quick way of entering market-related data into the computer via telephone hook-up or other sources. The purpose of the STKADD program is to allow one to enter HIGH, LOW, CLOSE, DATE, VOLUME and SYMBOL on a regular basis with such ease that a monotonous task seems automatic. Any stock, even those outside the 120 table elements, may be tracked for input to this program. All one needs is a stock listing. Following about 31 stocks (as in the STKADD table) requires at most twenty minutes daily.

The program is written in Cobol-80 version 3-22 (equivalent to Microsoft's Cobol-80) to run on a Cromemco Z-2H micro-computer. This program demonstrates the ease with which Cobol can be read, and points out that it is available for use on micros from many manufacturers and software houses. With a few minor changes and a simple I/O driver for your terminal, this program could run on any CP/M compatible system.

The ACCEPT and DISPLAY statement formats of this release make it exceptionally easy to program routine data-entry programs for full cursor control of one's terminal. The program is strictly one of data-entry and data-editing to set up the vast information you may choose to output at a later date. The user can select many options, such as the ability to restart anywhere within a selection of user-defined stock symbols, and the automatic generation of repetitive data when in the tabled mode. Other options include automatic editing of numeric data; free-form number, fraction or decimal entry for automatic numeral-decimal conversion of all stock-price data. A special subroutine converts all stock-price conversions to their equivalent numeral-decimal notation. The subroutine 'EDTPRICE' is not included, but is available upon request.

All of the informational data required for this program is readily available from various newspapers, journals or publications. For those requiring only weekly data, a weekly stock listing will do.

Every Cobol program is split into four divisions, each of which must be placed in its proper sequence and must begin with a division header. These four divisions are: IDENTIFICATION, ENVIRONMENT, DATA and PROCEDURE DIVISIONS. The division headers can be found in the program listing lines 1, 5, 16, and 128 in the order required.

The IDENTIFICATION DIVISION names the program and, optionally, the date the program was written and compiled, the author, and other documentary information. The ENVIRONMENT DIVISION describes the computer to be used, specifies the special machine features and describes the relationship of data with the actual input/output device(s). The DATA DIVISION defines the data and its characteristics used by the program (eg. numeric, alphabetic, signed, etc.) for both the input/output processing or internal program use. The PROCEDURE DIVISION consists of executable statements to process the data in the order written (unless another order has been specified).

With the structure of Cobol in mind, let's analyze the program STKADD. The SELECT statement (lines 13-15) is worthy of note. This statement defines the input/output file(s) (abbreviated as I/O), which in this case is assigned to a disk drive (IN-DRIVE 'C:' of line 124). A printer may also be assigned, but for output only. The file is sequential, and each line (record) is terminated by a carriage return (cr) making it a variable rather than

a fixed format. The maximum record length is 79 (line 22) characters. The SELECT is tied in with the FD (abbreviation for File Definition) statement (lines 19-22), which specifies the name of the file by the 'VALUE OF FILE-ID' clause. The data-name 'STOCK-INPUT-NAME' referenced on line 20 points to the actual file-name as found on lines 123-126. This file-name is the default: that is, it may be any other file-name of your choosing.

The WORKING-STORAGE section defines the different fields and attributes used in the program, while the FILE SECTION defines the attributes characteristic of the input and output file(s). Note the COPY statements (line 31 and 47), which allow previously defined program code to be included into this program through the use of an external file. The file-name C:STOCKINP. CBK (line 31) contains the code lines 32 thru 45, which define the record format. A similar statement is on line 47, C:STKTABLE. CBK is the name of the file containing lines 48 thru 101. These lines are actually a table containing a pre-defined set of stock-symbols and descriptions for stocks I wish to follow on a regular basis. The DOW 30 stock plus BALLY MFG are already tabled in the program. The table is similar to Basic's matrixes and in this case is a 120 dimensional table (occurs 120 / line 99). The table is limited to 120 tabled entries since no group of data (STOCK-TABLE / line 48) can be greater than 4,095 bytes. Each table element is 34 bytes (8 bytes for the STOCK-SYMBOL and 26 characters for the STOCK-DESCRIPTION).

Reading through the remainder of the WORKING-STORAGE section, one can discover the use of various switches and other data-names used by the program. The context of most are easily understood by the use of meaningful data-names. The MASTER-FILE-IN-STATUS (lines 119-122) is tied to the SELECT statement by the FILE-STATUS clause on line 15. Its purpose is to set various values to line 119 while in the process of opening, reading and writing the referenced file (all I/O operations).

The '88' levels below line 109 are called conditional-names. These conditional-names have a specific value assigned to them that can be used for logical operations in a comparison test. Instead of saying "PERFORM MAIN-DRIVER UNTIL STOCK-TABLE-SWITCH EQUAL 'E'," for example, you can use the conditional-name assigned to the value 'E', such as "PERFORM MAIN-DRIVER UNTIL USER-DONE". This line sample is on line 139 in the program listed. Conditional-names cannot be altered; they are used for referencing only.

Since you cannot change the values of conditional-names, one alters the contests of the data/conditional-name by changing the value of the data-name above the '88' levels. This can be done by a MOVE statement to the data-name. A perfect example of this is line 295 or line 297. Line 295 moves a '3' TO STOCK-TABLE-SWITCH (that's the data-name) if a stock-symbol requested is not found in the table. Line 311 uses the conditional-name equivalent (STOCK-TABLE-NOT-FOUND) for looping (perform..until..or). The same applies to line 313 to display a "NOT FOUND" message to the terminal screen. Reading data into the data-name can also change the contents of the data/conditional-name.

The PROCEDURE DIVISION contains specific instructions for the computer. All instructions are executed in the order as written, from top to bottom, unless the programmer has specified a different sequence by the use of a PERFORM, GO TO or CALL statement.

This release of Cobol allows user interaction with the terminal for all required data by special DISPLAY and ACCEPT verbs. DISPLAYs actually print the data (or literal) on the terminal screen, while the numbers enclosed in parentheses, immediately following the word DISPLAY (or ACCEPT), indicate the line and columns (in that order) where the data will be printed on the terminal. The DISPLAY (1 1) ERASE (line 130, 138, 168) clears the screen from the first line to the end of the screen (line 24, column 80); subsequent displays vary the cursor position before the data-name is printed. A sample of a literal (in quotes) is in line 131, while a sample of a data-name (without quotes) display is on line 182 where the data-name is SECURITY-SYMBOL. ACCEPT statements function as the DISPLAY with regard to cursor positioning; however, the program waits for your data or reply to be entered through the keyboard before continuing with the next instruction.

**Data-name length determines character maximum**

The limitation on how many characters you can enter depends on the length of the data-name defined, which becomes the maximum allowable characters entered, (although fewer characters may also be entered), but what is entered depends solely on what has been programmed in the instruction. In brief, if you look at line 40 for data-name SECURITY-SYMBOL, you will see a PIC X(8), which means eight alphanumber (X) characters. The ACCEPT on line 197 for this data-name would allow up to, but not more than, eight characters to be entered. A similar PIC 9(6) TRADE-DATE (line 35) specifies numeric values only (the 9) for six positions. The 'V' imbedded in the PIC clause (line 41-43) points to the decimal-point location, but not the physical decimal itself. This allows numeric data to be properly aligned on the decimal-point.

Other data characteristics worthy of note, although not used in this program, are the PIC A(9), which specifies a nine-character alpha value (A thru Z) only. A PIC S9(3) specifies a signed numeric value of three maximum bytes.

A PIC Z,ZZZ.99- is an editing feature that allows a numeric value to be printed with decimal alignment while allowing the leading zeros to be suppressed (not printed). The decimal-point along with the positional comma (,) and the decimal portion of the number will print, even if zero. If the number happens to be negative, the dash (negative symbol ' – ') will also print after the decimal number. Some samples are, PIC 9,999.99 (this will print even the leading zeros such as 0,001.99) whereas PIC Z,ZZZ.99 – will print 1.99 – only. If the number is positive, the sign will not print. The sign may be either negative ( – /db) or positive ( + /cr). Note that the CR/DB may be used instead of the plus/minus sign.

The PERFORM statement (equivalent to the GOSUB in Basic) is used to branch to a paragraph-name that follows the word 'PERFORM...', which then returns to the next statement after the branch (paragraph named) is done. Loops can be manipulated with a PERFORM through the use of counters, indexes or conjunctions such as UNTIL... or VARYING...FROM 1 BY 1 UNTIL. These are similar to Basic's FOR I TO...NEXT, etc. A 'GO TO' statement in Cobol works the same as in Basic; that is, you do an unconditional branch to another

paragraph but do not return to the next statement after the GO TO. Basically, the 'GO TO' and 'PERFORM...' statements control the program flow. Many variations of these statements allow looping, branching, and may be either conditional (IF...PERFORM/GO TO) or unconditional (PERFORM/GO TO).

The IF statement is used for logical tests to determine if a special routine/function or condition exists and requires special instructions. IF statements may even be nested as on lines 147 thru 160. (Nesting means multiple IF statements within an IF statement and before the ELSE.) Usually IF statements are used in conjunction with PERFORM or 'GO TO' statements.

The MOVE statement in the PROCEDURE DIVISION of a Cobol program allows movement of data, records, fields or literals (the "from" field) to any other data area within the DATA DEVIATION (the "to" field). The length of the MOVE(d) field is determined by the length of the receiving (to) field. All moves are from left to right, with space-fill or truncation to the right unless the data-name is numeric, in which case, the move is from right to left and aligns on the decimal if specified.

To store or retrieve information in a table (or matrix) requires the use of an INDEX-NAME (or subscript) to point to a particular element in a table. The SET statement is used to update the contents of an INDEX-NAME with either an up or down movement or a specific numeric value. To manipulate table entries, a MOVE or SEARCH statement is commonly used in conjunction with the index-name and data-name (e.g. line 181 / with a MOVE, line 294 shows a sample with the SEARCH... WHEN statement). PERFORMs are also commonly used to update the pointer (INDEX-NAME). INDEX-NAMES are normally defined at the same time as the table. A sample INDEX-NAME is STK-TBL-INDEX line 99, and is part of the INDEXED BY clause for the STOCK-TABLE (line 48 thru 101). An index may not be less than one (1), nor should it be greater than the "occurs" number (120 in this case) unless one wishes his program's WORKING STORAGE areas to be clobbered.

At lines 134-135, there is an ACCEPT statement for the data-name STOCK-INPUT-NAME. I will break this statement down to its optional components and explain what this ACCEPT allows you to do.

The data-name STOCK-INPUT-NAME currently contains C:STKINPUT.DAT (lines 123-126) and the UPDATE option allows the contents of STOCK-INPUT-NAME (C:STKINPUT.DAT) to be displayed (as default) and changed if required. The AUTO-SKIP option allows automatic termination of this command once all characters of the specified data-name are filled in (length of STOCK-INPUT-NAME is 14 bytes). The PROMPT option allows prompting (user interaction), while the BEEP allows the terminal, if equipped, to make an audible sound.

Another point of interest in this program is the CALL statement (line 284). This functions as in Basic, to "call" in another program or subroutine from the program currently residing in memory. To call a subroutine, issue a 'CALL' via a call statement, followed by the subroutine ('EDTPRICE' in this sample) then the word USING (if parameters are required) followed by the required parameters in the sequence necessary for the subroutine. To function, this subroutine 'EDTPRICE' requires three parameter values to be passed to it, the input (EDIT-IN), the output from the subroutine (EDIT-OUT) and a status code field (ERROR-CODE). The length of each field must be the same in both the calling (STKADD) and the called (EDTPRICE) program; the data-names, however, need not be the same.

The subroutine's main function is to take any mixture of whole numbers and decimals or fractions and spaces

```

          ***  STKADD     MENU    VERSION 80.310   ***


          YOUR FILE NAME IS           C:STKINPUT.DAT

```

**Screen 1. Displays STKADD banner and allows any file-name to be used for this program.**

```

    TYPE IN
           Ø OR E     TO BYPASS STOCK SELECTION OR TO END THIS PROGRAM
                      HIT ANY OTHER KEY TO CONTINUE
    ENTER REPLY?      _

```

**Screen 2. Reply 0 or E terminates the table-mode option; any other key allows continuation of table-mode feature for stock selections.**

```
TYPE IN
          Y          TO RESTART FROM ANY TABLED ITEMS
                     HIT ANY OTHER KEY TO CONTINUE
ENTER REPLY?
```

**Screen 3. Applicable only if in the table-mode selection. This allows restarting from a pre-defined stock selection table (reply Y); any other key starts selection from first entry in the table.**

```
TYPE IN
      STOCK SYMBOL TO RESTART FROM FOLLOWED BY RETURN KEY  CR

ENTER REPLY?   ABCDEFGH

STOCK SYMBOL ABCDEFGH IS NOT FOUND *** TRY AGAIN?
```

**Screen 4. Applicable only if in the table-mode and a restart (screen 3) was requested. Allows entering a stock-symbol from table selection for restarting.**

```
ØØØØØØ        TRADE DATE MMDDYY
```

**Screen 5. Applicable when in the table-mode. Allows date to be used for subsequent tabled entry.**

in order to arrive at a converted whole-number (integer) decimal combination. The resulting decimal is computed to five-point accuracy, which is plenty for any market-related price information. A closing stock price of 10½, 10.5, 10 5, or 10-4 into the subroutine 'EDTPRICE' will return with a value of 00001050000, with the decimal point assumed prior to the 5 (see EDIT-OUT line 26). This may seem easy or trivial, but while keying the information, don't convert fractions to a fixed format prior to keying the information since it would delay the procedure. The micro can do these simply. What's the decimal equivalent of 1/32? Let the machine worry about it. The built-in limitation to this subroutine is that the whole number must not exceed 999999 (the 9[6]).

Other restrictions are in the special meaning of the dash (-), slash (/), asterisk (*), the capital letter 'T', and the space following the whole number. The dash means the following number is in eighths, the number following the asterisk is in sixteenths, and the 'T' signals that the number following is in thirty seconds. A fraction may also be entered, (such as 1/8), but it must follow the whole number by one blank character. A decimal number may be used in the same way as a dollar and cent figure; the decimal-point itself may be omitted. All these techniques were programmed to eliminate the keystrokes that were repetitive in nature, such as the denominator portion of the fraction.

Most microcomputer configurations include the Central Processing Unit (CPU), a terminal screen with a keyboard, a printer, and one or more floppies and/or hard disk drives. The keyboard is commonly used to interact with microcomputers to perform a task, respond to a message, receive a status of activity or print a file directory. The terminal screen is normally 24 lines down and 80 columns across. The 25th line is a status display line and is not commonly available for input data. Note the sample screens pictured here. On Screen 6, notice the horizontal lines marked at the

bottom from left to right (1 to 80). These are the columns, while the vertical lines shown on both the left and right margins are numbered 1 to 24. Line 1, column 1 is the very first position on the screen. Line 24, column 80 is the last position on the screen.

Let's observe some of the user interaction with the terminal when using the program. As you type in STKADD in response to your CDOS/CP/M prompt, the first screen you will encounter is the STKADD banner and the program version number on lines 2 and 3 of your screen. (See Screen 1.) This code can be found in the GET-INPUT-FILE-NAME paragraph of the PROCEDURE DIVISION, lines 129-135. On line 4 of Screen 1 layout, the program will ask 'YOUR FILE NAME IS...', followed by the default file-name C:STKINPUT. The cursor positions under the "C", as shown by the underline. If your input/output file-name matches that of the default, hit the RETURN-KEY (CR). To change the default, re-type the correct drive, the file-name and the extension, as appropriate. The drive may be assigned to any existing floppy or hard-disk. I use drive "C" (hard-disk), since the speed is much faster than writing to a floppy disk unit. Once you type the fourteenth character or the RETURN-KEY (cr), the program will continue by opening your file in the EXTEND mode (line 137 of the program listing). What EXTEND means is that your file *must exist* and will append all new records (from this session) to the end of an existing file. The file itself need not have any data. SCREEN.COM may be used to create a file-name for input by this program.

Screen 2 coding can be found in the DISPLAY-TABLE-BYPASS paragraph (lines 238-248). This screen allows you to end the STKADD program or the table-mode option (if appropriate) by replying with an 0 or E. To add more data or stay in the table-mode, hit any other key.

Screen 3 will only be displayed when in the table-mode. That is, the table (DOW 30) in the program is used to determine which stocks the user wishes to follow. The screen allows you to re-start on any stock within the table. So it is not necessary to do the first, second,...last, in that order. You may start with whatever stock symbol is in the table, even the last one. This screen is code paragraph DISPLAY-RESTART, lines 250-259.

Screen 4 will only display when a restart is requested (Screen 3), and its purpose is to request the stock-symbol to restart from. The GET-RESTART-SYMBOL (lines 299-315) is the code for Screen 4. Line 12 in the

```
 1                                                                                 1
 2  TYPE IN REQUESTED INFORMATION     .....     RECORDS ADDED = ØØØØ9               2
 3                                                                                 3
 4                                                                                 4
 5                                                                                 5
 6                                                                                 6
 7                                                                                 7
 8                                                                                 8
 9                                                                                 9
10   122480          TRADE DATE MMDDYY                                            10
11   T               AMERICAN TELEPHONE & TELEGRAPH                               11
12   1457               VOLUME     IN 1ØØS    LIMIT 9999999                       12
13   49-1               HIGH       -FORMAT WHOLE NUMBER SPACE, PERIOD (.), DASH (-) 13
14                           FOLLOWED BY DECIMAL OR FRACTION. MAX VALUE 999999.99999 14
15                                  HIT RETURN-KEY  CR  WHEN DONE                 15
16   48 5               LOW        -FORMAT SAME AS ABOVE                          16
17   48 75              CLOSE      -FORMAT SAME AS ABOVE                          17
18                                                                                18
19                                                                                19
20      TYPE IN                                                                   20
21            Ø OR E   TO RETYPE LAST TRANSACTION                                 21
22                     HIT ANY OTHER KEY TO CONTINUE.                             22
23      ENTER REPLY? _                                                            23
24                                                                                24
    12345678911234567892123456789312345678941234567895123456789612345678971234567898
             0         0         0         0         0         0         0         0
```

**Screen 6. Main-menu display to enter DATE, STOCK-SYMBOL, VOLUME, HIGH, LOW and CLOSE. Also allows correction in case an error has been made. RECORDS ADDED is a count of valid entries added to input file.**

```
16
17    TYPE IN
18           Ø OR E     TO TERMINATE ADD FUNCTION
19                      ANY OTHER KEY TO CONTINUE
20    ENTER REPLY?      _
21
22
```

**Screen 7. Allows termination of STKADD and to return to the operating system (CDOS).**

```
19
20   TYPE IN
21          Ø OR E    TO END TABLE SELECTION
22                    HIT ANY OTHER KEY TO CONTINUE.
23   ENTER REPLY?     _
24
```

**Screen 8. Allows exit from the table-mode.**

layout will only be displayed if the stock symbol requested (line 10 of layout) is not in the table. It will wait for a correct reply before continuing.

Screen 5 will be displayed only if in the table-mode. The reply must be numeric, but no other editing will be done on this field for proper month, day or year. This screen code is in paragraph STOCK-TABLE-MAIN-LINE (lines 162-167). The date typed to the above message will be used for all tabled items from the starting (or restart) stock symbol until the last stock symbol of the table is done (once only).

Screen 6 is the DISPLAY-MENU paragraph lines 174-211. This is the menu you will encounter the most. In the table-mode, the TRADE-DATE (entered thru Screen 5 reply), the security-symbol and the description (from the selection table) are automatically displayed and will not ask for a prompt. When not in the table-mode, the program will prompt the user for the date and stock-symbol. All the information to the right of the screen will be displayed first. Then the cursor will position to the left of the displays to terminal line numbers 10, 11, 13, 16 and 17 (as appropriate) from top to bottom until the last field, the closing price information line 17, is filled in. Once the cursor has moved to a new line, it is impossible to correct the prior line. Corrections can be made. The only numeric fields on Screen 6 are the TRADE-DATE and VOLUME (in 100s); the remainder are alphanumeric. The price information uses a mixture of numerics, decimals, blanks and characters that have a special meaning. These were discussed previously. If an error is made in the price fields, corrections may be made as long as the cursor is on the same line to be corrected. Again, a prior line cannot be changed once the cursor is below it, except as outlined below. Screen 6 (terminal lines 20-23) does not display until the last field (the closing price / line 17 on the terminal) is terminated. This reply allows one to re-do the current Screen 6 information if an error is made. Note terminal line 2 shows the number of "RECORDS ADDED" to the file since the STKADD session started. When re-entering data (reply E / terminal line 23 of this menu), neither the record count nor the file is updated.

Screen 7 is part of the DISPLAY-END-OR-CONTINUE paragraph code lines 261-273. It allows termination or continuation of the STKADD session.

Screen 8 (lines 227-233) will only be displayed if it is in the table-mode. It allows the table selection to terminate, but allows other stocks not in the table to be keyed.

I have used very meaningful names in this program in order to be self-documenting, especially for those who understand the language of the stock market. New updates to this program now allow an additional external file as input for selection of those stocks to be keyed in addition to, or in lieu of, the tabled Dow 30. Additional editing features have also been included, such as displaying the converted prices on the screen and ensuring that all price information is consistent (e.g. HIGH is not less than LOW, etc), and that the volume is not zero. □

***Program on page 154***

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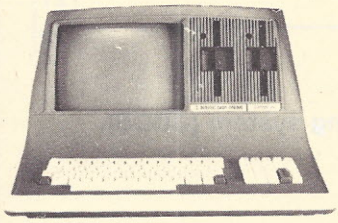

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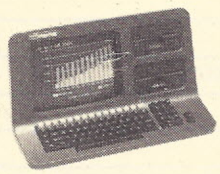

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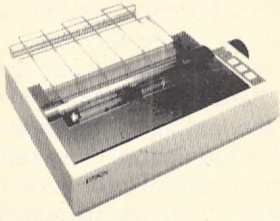

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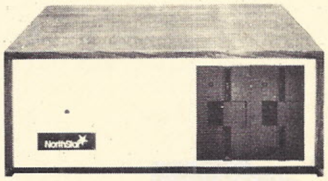


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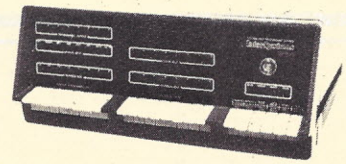

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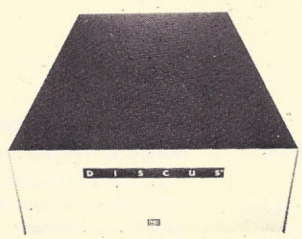


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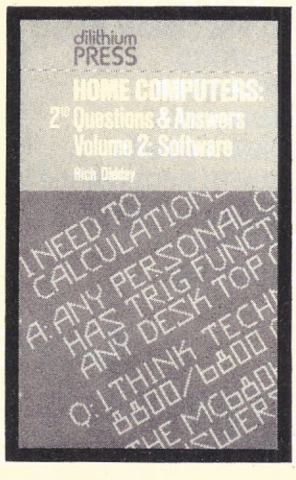


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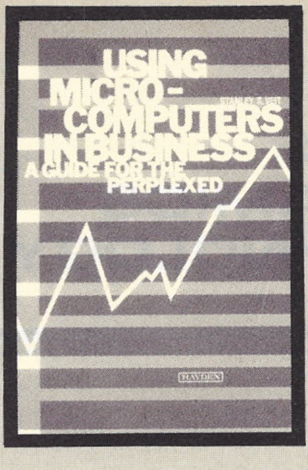


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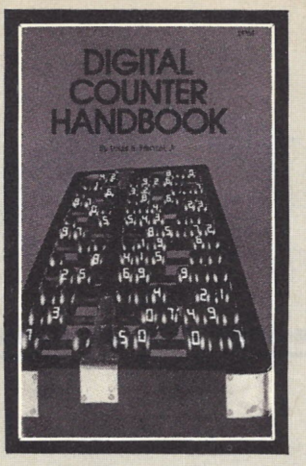


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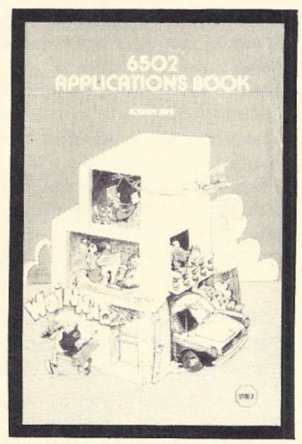


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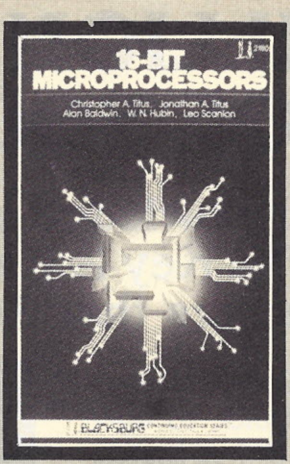


## 16 Bit Microprocessors
***Christopher A. Titus, Jonathan A. Titus, Alan Baldwin, W.N. Hubin and Leo Scanlon***

The book begins with a review of basic microprocessor concepts, as it is assumed that you have had some experience in microcomputers. The Intel 8086, Zilog Z8001 and 8002, DEC LSI-11, Texas Instruments 9900 and family, Motorola 6800 and National Semiconductor 16000 family are discussed. Benchmarks have been included for each processor, and the appendix contains benchmark specifications.

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## 6809 Microcomputer Programming and Interfacing
***Andrew C. Staugaard, Jr.***

This book was written to provide you with a sound understanding of how to program and interface the 6809 microprocessor. The first half of the book discusses the chip structure and basic concepts of the 6809. Addressing modes and registers and data movement instructions are also covered. The next chapter deals with branching and other instructions. Input and output are detailed; interfacing and applications of the 6809 are discussed.

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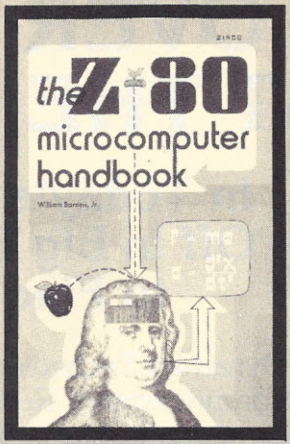


## Z-80 Microcomputer Handbook
***William Barden Jr.***

This handbook will provide the current Z-80 user and the prospective user with essential information on technology of the Z-80. Organized into three sections, the first section concentrates on hardware; second on software and the third on microcomputers built around the Z-80.

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***Howard Bierman, Paul Bierman and Rufus Turner***

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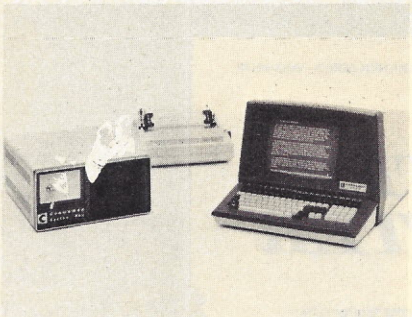
# NEW PRODUCTS

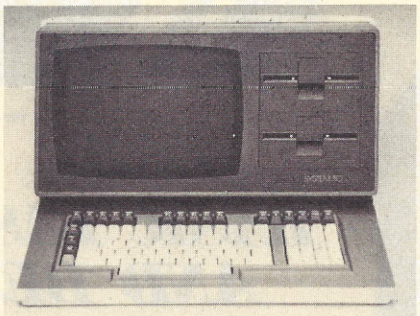
**Desktop computer,** System One, was designed for both multi-user and single-user applications, providing substantial room for expansion, so that the machine can be configured to meet individual requirements. It is provided with Cromemco's powerful Z-80A-based CPU, 64K of RAM memory, a printer interface, and dual quad-capacity 5-in. floppy disk drives. These drives provide 780K of storage capacity. The 8-slot card cage included provides substantial room for expansion. Consequently, it can be easily configured for specific requirements by



adding additional memory and I/O cards. The computer includes system diagnostics that enable a quick test of the system to see that the memory, controller, and disk drives are properly functional. It is designed for use with 110/220 volt 50/60 Hz power. Voltage selection is user-selectable by means of convenient push-button switches on the rear panel of the machine. Currently available system software includes Structured Basic, Fortran, Cobol, C, RATFOR and LISP. Price: $3,995. Cromemco, 280 Bernardo Ave., Mountain View, CA 94043, (415) 964-7400.
**CIRCLE INQUIRY NO. 220**

**Wangwriter enhancements** include the Wang CP/M release 2.2 operating system; telecommunications capabilities, such as 2780/3780 emulation and TTY (which permits access to on-line data bases); a two-disk version of the current 96K model Wangwriter with a storage capacity of 640,000 characters; a single- and two-disk version of a new 128K model Wangwriter; and advanced editing functions, including math, sort, merge, and pagination. In addition, the Wangwriter's document-handling capability has been extended from 15 to 75 pages of text (available in the U.S. in December of 1981). Currently installed single-diskette Wangwriters can be upgraded to accommodate these new optional features. Price: $200. Wang Laboratories, One Industrial Ave., Lowell, MA 01851, (617) 459-5000.
**CIRCLE INQUIRY NO. 221**

**Business computer,** System 10, does everything most small business need from a computer—including word processing, financial modeling, accounting, stock control, data base management and payroll, all with readily available CP/M software. Larger business users can use it for mainframe processing and data entry. The amount of computational power required can be supplied with a high-speed 8-bit microprocessor, the Z80. Data transfer operations within the system are speeded by use of a DMA controller chip, interrupt controller, and interval timer. Its memory consists of 65K of Read/Write RAM and 2K of PROM. It provides from 700K to 5M bytes of disk storage by using double sided, double density, 5¼-in. disk drives and 5¼-in. Winchester hard disks. A



separate microprocessor handles control of the keyboard and CRT display, allowing great flexibility in managing on-screen data. Features include clear to end of line, addressable cursor and a 38K baud transfer rate. Other features include power-down disk protect, allowing the system to be turned off with the disks in place with no risk of damage; switching power supply for cool, reliable operation. Data Technology Industries, 700 Whitney St., San Leandro, CA 94577, (415) 638-1206.
**CIRCLE INQUIRY NO. 222**

**Laboratory Computer,** ISAAC, converts the Apple into a real-time industrial computer system for data acquisition, instrument control, automated testing, and process control functions. Fields of application include chemistry, engineering and life sciences in industry, research and education. The system includes encased

input/output hardware, Labsoft extended Basic software, and step-by-step user instruction in self-teaching, tutorial style. The system is complete and requires no prior computer experience. Capabilities, including sampling rates, are competitive with many larger computers costing two to three times more. Detachability of the case from both the Apple and the instrument connection panels allows application flexibility and portability. The Apple can easily be disconnected and moved for separate word processing, accounting and personal uses. The system can also be used for front-end processing to central computer systems. Price is $7,250 complete with Apple II Computer, disk drives and color monitor; or $3,950 if purchased as an add-on to an existing Apple system. Cyborg Corp., 342 Western Ave., Boston, MA 02135, (617) 782-9820.
**CIRCLE INQUIRY NO. 223**

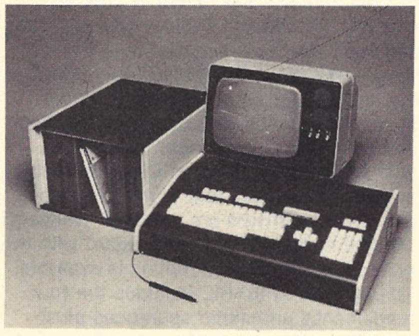
**Multi-user computer,** System 12B, contains 328K of memory and supports four simultaneous users. The system employs a 10 Mbyte fixed/removable hard disk drive with the capability of supporting a total of several hundred Mbytes of online disk storage. The system employs the Multi-user SDOS operating system and runs the complete library of MSI business software modules, which include: inventory control, bills of material, sales order entry, accounts receivable, purchase order entry, accounts payable, payroll and a completely integrated general ledger package. These systems start with a 64K computer priced at $2495. Midwest Scientific Instruments, 220 W. Cedar, Olathe, KS 66061, (913) 764-3273.
**CIRCLE INQUIRY NO. 224**

**16-bit system,** Wicat 150, includes an MC68000, 16-bit processor, memory, CRT, storage and storage back-up all in a single desk-top unit that weighs 50 lbs. It measures just 16 in. high, 19 in. wide and 16½ in. deep. Executing approximately one million instructions per second, the processor runs at 8MHz. Although this processor has a 16-bit external data path, internally it has 32 bit registers and supports 32 bit operations. Main memory ranges from 256K bytes to 1.5M bytes and

standard mass storage includes a 10M-byte Winchester disk drive and a 960K-byte 5¼-in. floppy disk drive for back-up purposes. The versatile model can be configured with storage options using two 160K-byte or 960K-byte 5¼-in. floppies, or as an intelligent terminal without mass storage. In addition to graphics capabilities, hardware options include videodisk interface and battery back-up. The system supports two RS-232C serial interfaces and a 16-bit parallel interface. The nine programming languages

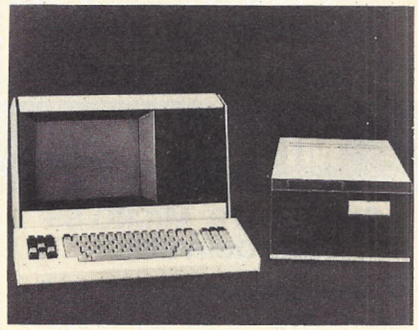
supported are Pascal, C, APL, ADA, Cobol, Fortran, LISP, WBasic and Assembler. Prices start at $4,000. Wicat Systems, 1875 S. State St., Orem, UT 84057, (801) 224-6400.
**CIRCLE INQUIRY NO. 225**

**Desktop computer,** the MTU-130, incorporates a 256K byte address space, 480 by 256 hi-resolution graphics, up to four Mbytes storage on floppy disk, and special anti-piracy hardware to allow vendors to protect software. The computer enclosure features a keyboard with 96 keys, including full numeric keypad, cursor keys, and 10 programmable function keys plus a fiber-optic light pen. Inside the cocoa-brown case is an expansion card cage with slots for four large expansion boards in addition to the single-board computer, a power supply, fan, and a one-watt audio amplifier and 5-in. by 3-in. speaker. Rear connectors are provided for the RS-232 and two parallel I-O ports as well as switched AC outlets. Separate packages house the hi-resolution green-phosphor CRT and 8-in. disk drives. Extensive software is included with the system, including CODOS, an advanced disk operating system with UNIX-style files and device-independent input-output. Microsoft Basic has been enhanced to allow programs to specify libraries of additional commands appropriate to the application. Standard libraries supplied include graphics commands and operating system interface commands. The system's 80 character, 25 line display is used to maximum effectiveness by the standard full screen editor, which can rapidly edit files of any size up to a full disk. Also included is a four-voice music package, which uses the system's standard 8-bit digital to analog converter and filter to produce high-quality music. Many other programs are included, ranging from a fast disk-backup



utility to a terminal emulator for RS-232 communications with other computers. Micro Technology Unlimited, Box 12106, 2806 Hillsborough St., Raleigh, NC 27605, (919) 833-1458.
**CIRCLE INQUIRY NO. 226**

**Desk-top microcomputer,** Model XP/4, has a 20M-byte Honeywell Bull hard disk drive, featuring a 10M-byte removable cartridge and a 10M-byte fixed platter. This system, which has hard disk storage only (no floppies)—is intended for applications that require high capacity, fast access storage with easy backup capabilities. Standard XP/4 features include: Z-80 microprocessor, 64K of RAM (standard), a 24 line by 80 character CRT with anti-glare amber screen, serial communications channel and a Centronics-compatible parallel printer interface, all packaged in a white hammertone finish cabinet. The hard disk drive is packaged in a separate matching cabinet. System options include a selection of dot matrix or daisy wheel printers. The system is supported by the



CP/M Operating System, with Microsoft Basic (Interpreter and Compiler), Fortran and Cobol available, as well as the Wordstar word processing system. Prices start at $15,250. Commercial Computer, Box 39355, Solon, OH 44139, (216) 248-8131.
**CIRCLE INQUIRY NO. 227**

**Fully integrated computer system,** model 48 IEEE-488 bus controller, has at its heart a 4-layer, single-board GPIB controller that features two independent GPIB ports, each with a bus transfer rate in excess of 14K bytes/sec. The controller also includes an RS-232 serial port and two parallel data ports. The model features a built-in 12-in. CRT with a full 80-by-24



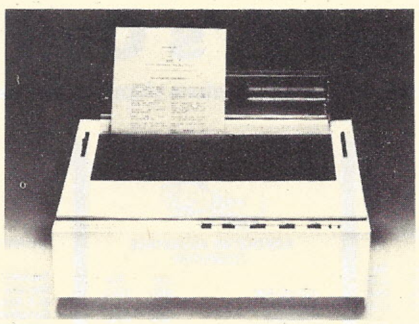


**CIRCLE INQUIRY NO. 7**

character display. The monitor, which has scrolling capability, features a 25th line for displaying system status as well as the time and date. A standard Qwerty keyboard is used for manual entry of data. Up to 132 columns of hard copy are provided by an optional impact dot-matrix printer. The system contains 64K bytes of internal memory. An additional 350K bytes of mass storage capacity is supplied by a 5¼-in. floppy disk drive. An optional second drive can increase storage capacity to 700K bytes. The model 48, which contains Z80 and 8085 microprocessors, is supplied with the industry-standard CP/M operating system. In addition, text editor, assembler and debug software are provided. Although 16-digit math precision is standard with the unit, an extended math option is available. The math in GPIBASIC includes the four fundamental arithmetic operations plus logarithms, exponentiation and other sophisticated functions. The extended math option greatly increases the speed of operation. Price: $5,500. Systel Computers, 538 Oakmead Parkway, Sunnyvale, CA 94086, (408) 746-2901.

**CIRCLE INQUIRY NO. 228**

**Daisy printer,** Alphacom DP 2000, features include: proprietary, long life 100-character print wheel, which offers a greater variety of special symbols not available on standard 96-character versions and allows for use with several languages without time consuming print wheel changes; four major print modes, including normal, automatic underlining, boldface, boldface underlined and many others. The DP 2000 with standard parallel interface is priced at $1,695 and $1,795, with IEEE



488 or RS232C. Alphacom, Inc., 2323 S. Bascom Ave., Campbell, CA 95008.

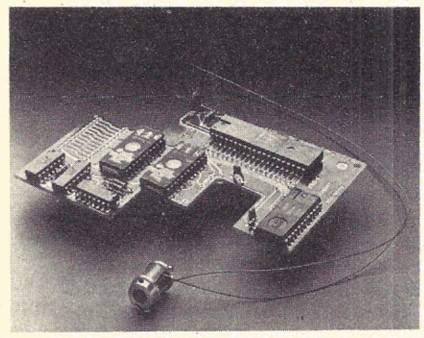
**CIRCLE INQUIRY NO. 229**

**Printer with drafting capability** has been added to the MX series. Standard features of the Epson MX-82 F/T include

wide variation of printing widths and character sizes, top of form, skip-over perforation, programmable line and form feed length, vertical and horizontal tabs and three-way paper handling. Additional features include plotter printing, text and graphics printing, "throw away" print head, bidirectional print with logic-seeking, error buzzer, out-of-paper detector, self-test and eight international character sets. Epson Shinshu Seiki, 80 Hirooka, Shiojiri-shi, Nagano, 399-07, Japan.

**CIRCLE INQUIRY NO. 230**

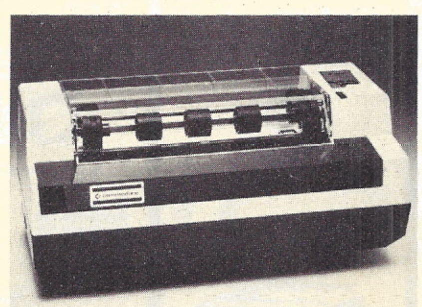
**Printer modification,** TXP 136, turns the standard Texas Instruments 743 or 745 into a 136-column data terminal. The unit allows the normal 80-column Silent 700 terminals to print 136 columns by a simple replacement of the socketed microprocessor with a small printed circuit



board, and changing the motor pulley and cable. The modification has been approved by Texas Instruments for installation in TI 743 or 745 data terminals without affecting the warranty of the Silent 700 terminal. TXP 136 is available from Texprint in tested kit form at $375 or installed in your TI 743 or 745 at $495 or from TI terminal distributors nationwide. Texprint, 8 Blanchard Rd., Burlington, MA 01803, (617) 273-3384.

**CIRCLE INQUIRY NO. 231**

**Personal computer printer** for the Vic 20 can print any of the alphabetic, numeric and graphic symbols common to the Vic 20 and is a dot matrix printer with a speed of 30 characters-per-second. The Vic 1515 allows the computer user to create copy



on paper for forms, program listings, mailing labels, charts, graphs and more. Special enhancements also allow the printer to print extra-wide and reversed (negative) characters. Price: $395. Commodore Business Machines, 681 Moore Rd., King of Prussia, PA 19406, (215) 337-7100.

**CIRCLE INQUIRY NO. 232**

**PROM/ROM expansion board,** BLC-464, is compatible with systems using up to 24 address lines, and can accomodate both 8-bit and 16-bit data paths, and a total of

16 PROM/ROM devices including the (1K by 8) 2758, (2K by 8) 2716/2316, (4K by 8) 2732/2332, and the (8K by 8) 2764/37000. The board is a plug replacement for SBC-464, but provides twice as much memory storage. It can also plug directly into any Multibus-compatible card cage, such as the BLC-604/614 system unit, via a standard 86-contact connector. Four address lines on a P2 connector are used for the auxiliary address lines necessary in larger systems. The BLC-464 user can select memory size, memory organization, base addresses, and board access time (minimum access time ranges from 35nS to 1435nS) with on-board DIP switches, option blocks, and Berg jumpers. The board address is assignable anywhere within 16M-byte memory. Price: $570. National Semiconductor, 2900 Semiconductor Dr., Santa Clara, CA 95051, (408) 737-5000.

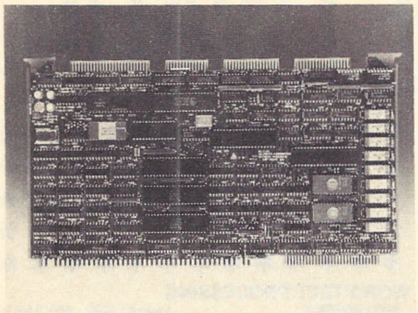
**CIRCLE INQUIRY NO. 233**

**Dynamic RAM boards,** provide up to eight times more memory than previous boards. The memory expansion boards range in size from 16K bytes to 512K bytes and are compatible with 8-bit and/or 16-bit single-board computers. All the boards offer on-board parity with the exception of the 16K-byte board. In addition, all are upward compatible with existing Multibus RAM boards. Based on 64K and 16K RAM chips, the memory expansion boards offer a combination of larger memory size and lower prices. The series includes first high-density 128K-, 256K- and 512K-byte boards for Multibus systems, giving designers the opportunity to use two, four, or eight times more memory on a single board than was previously possible with RAM expansion boards. The new 32K-through-512K-byte boards generate byte-oriented parity during all write operations and perform parity checking during all read operations. When a parity error is detected, these boards can generate an interrupt on the Multibus interface. Information on the row and bank of the RAM array containing the error is stored in a parity flag register, which is accessible as a Multibus I/O port. An on-board LED also provides a visual indication that a parity error has occurred. Prices: iSBC 016A board (16K): $705; iSBC 032A board (32K with parity): $955; iSBC 064 board (64K): $1,150; iSBC 064A board (64K with parity): $1,310; iSBC 028A board (128K with parity): $1,810; iSBC 056A board (256K with parity): $3,195; iSBC 012B board (512K with parity): $3,995. Intel Corp., 5200 N.E. Elam Young Parkway, Hillsboro, OR 97123, (503) 640-7147.

**CIRCLE INQUIRY NO. 234**

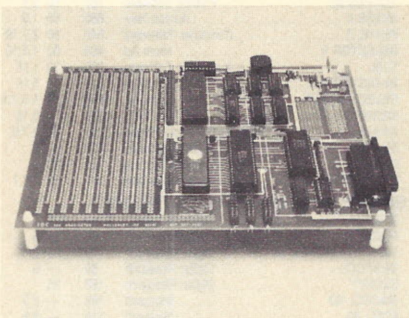
**Single-board microcomputer,** MLZ-92A, features: Z-80A CPU; DMA controller; Memory mapping RAM; I/O mapping RAM; double-density floppy disk drive controller; 64K write protectable on-card RAM - with parity; sockets for up to 16K bytes EPROM; 20 bit bi-directional Multibus interface (Multimaster or slave mode); APU on-card; Four counter/timers; Winchester interface; Streamer tape interface; two serial ports with RS232 or RS422 interface; two serial ports with RS232 for a total of 4 serial ports; option DIP switches and LEDs;

Both I/O devices and memory accessible from off-card; and Centronics compatible



parallel port. Heurikon Corp., 3001 Latham Dr., Madison, WI 53713, (800) 356-9602.
**CIRCLE INQUIRY NO. 235**

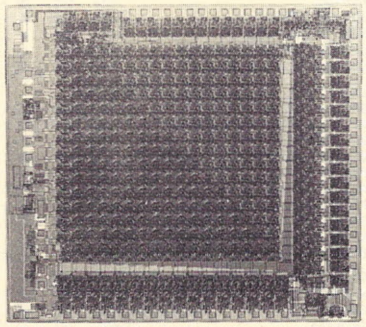
**Programming/design subsystem,** the IDC-8, is compatible with other computers driven by the 8088, including IBM's



personal computer. The IDC-8 is fully assembled and tested, and includes a 5MHz 8088 microprocessor, monitor software in an 8755 I/O ROM, 1K of Static RAM, 256 bytes of I/O RAM, and an 8251-based CRT interface. The I/O ROM and I/O RAM have total of 38 parallel I/O lines. The unit requires 5 volts at 1 amp, and communicates to the user via an RS232 terminal. The IDC-8 also contains over 18 square inches of wire-wrap area for special design applications, card expansions, the addition of peripheral support circuitry, and the addition of CPU memory. Price: $399. Intelligent Devices Corp., One Cameron Pl., Wellesley, MA 02181, (617) 237-7327.
**CIRCLE INQUIRY NO. 236**

**Dynamic memory module,** 2066, supplies 65,536 bytes of 2114-type dynamic RAM to a wide range of Z80 and 8080 CPU-based systems, as well as Cromemco Cromix, Cromix DMA, and Alpha Micro systems. The module supports both DMA and non-DMA applications with fast, 200 nS access time. Noise immunity and minimal bus load hysteresis circuitry insure performance and system integrity. Features include phantom overlay capability in both hard and soft modes, and on-board refresh using non-interfering refresh control logic. The complete memory bank is refreshed every two mS to maintain data integrity. Price: $995. California Computer Systems, 250 Caribbean Dr., Sunnyvale, CA 94086, (408) 734-5811.
**CIRCLE INQUIRY NO. 237**

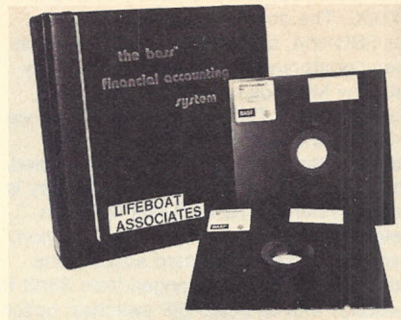
**16-bit parallel multipliers,** the Am29516 and Am29517, utilize an unclocked combinatorial array to produce a 32-bit product in no more than 80 nS over the full military temperature range. Am29516, a plug-in replacement for TRW's MPY16HJ, is 2.5 times as fast. Am29517, a proprietary device, is optimized for microprogrammed system applications and differs from the Am29516 in that the '517 has one system clock and three register clocks, while the '516 has separate clocks for each of its two inputs and two output registers. A single-clock approach eliminates the problem of clock delay and skew, which



result from external clock gating. Both devices feature internal ECL circuitry for high speed. In addition, the parts have TTL-compatible I/O ports for maximum interface flexibility. Only a single 5V power source is required for operation. A unique feature of the multipliers is the multiplexing of the least significant half of the product through the product output port. This allows the user to obtain a full 32-bit product (comprised of both the least and most significant halves) at a single output port. This feature is particularly advantageous for use in expansion schemes where a large multiplier array is being designed to handle long word-width multiplications. Price: $157 each in 100 piece quantities. Advanced Micro Devices, 901 Thompson Pl., Sunnyvale, CA 94086, 732-2400.
**CIRCLE INQUIRY NO. 238**

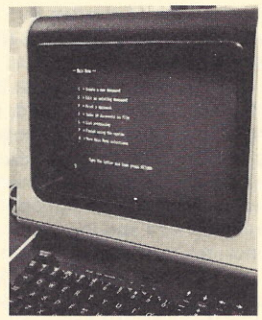
**General purpose accounting system** provides integrated, on-line processing for sales orders, purchase orders, inventory control, general ledger, accounts receivable and accounts payable. Its multiuser features include support of multiple printers, user password security, multiuser access to common data bases, menu-driven utilities for system backup and restore and support of mixed brand video terminals. Multiuser Business Manager also includes a built-in training system, menu help options and a facility for converting existing single-user business manager systems to the new multiuser version. It is developed for the MP/M environment. Dynabyte, 115 Independence Dr., Menlo Park, CA 94025, (415) 329-8021.
**CIRCLE INQUIRY NO. 239**

**Financial accounting package,** The Boss, combines general ledger, accounts payable and accounts receivable on a single program. The software provides the simplest procedures to date for entering data, posting transactions and generating reports with a microcomputer. Designed for easy use by accounting professionals and business managers, it also produces a multitude of financial reports, such as loan payment calculations and financial ratio analysis. The program runs under the CP/M operating system. Price: $2,495, including




the program disk and instruction manual. Lifeboat Assoc., 1651 Third Ave., New York, NY 10028, (212) 860-0300.
**CIRCLE INQUIRY NO. 240**

**Word processing package,** CT*OS version 4, is available to run under a variety of operating systems, including its own



operating system for single terminal use, RSTS/E, RSX-11M and VAX/VMS; thus allowing it to operate in the full range of DEC LSI-11, PDP-11 and VAX systems. Written entirely in Macro-11 machine language for efficiency of memory usage and processing speed, the package presents a minimal overhead load for simultaneous WP/DP operations, both in single and multiple station (up to 90) configurations. For example, a single station system requires 56K bytes of memory. Both DEC VT-52 and VT-100 intelligent terminals as well as a wide range of letter and draft quality printers: Diablo, NEC, Qume, Sanders and DEC are supported. German, French and Dutch language versions are available. Prices: standalone, $2,200 (single CPU license), with RSTS/E and RSX-11M versions at $3,600, and VAX available for $4,200. Compu-Tome, 234 E. Colorado Blvd., Pasadena, CA 91101, (213) 960-2895.
**CIRCLE INQUIRY NO. 241**

**Statistical package** consists of five programs that perform descriptive statistics, and single and multiple variable regression. Features include analysis of variance with unequal sample sizes, unprecedented flexibility in formatting post hoc and planned comparison analysis, and computation of percentile ranks of F ratio statistics. The Multiple Linear Regression program allows for testing of significance of Beta weights, gives regression statistics for any subcorrelation matrix, finds the significance of adding variables to the regression, and

calculates a predicted Y value for input X values, complete with confidence limits and percentile ranks for the F ratio. All the programs allow for easy input, output, and editing of data and are written for TRS-80 models I and III. Price: $39.95. Bruce P. Douglass, 20 Willow, Vermillion, SD 57069.
**CIRCLE INQUIRY NO. 242**

**Filing program,** VisiFile, increases the usefulness of a personal computer for keeping business records. The program's flexibility allows many different applications —inventory, client lists and records, sales information, medical records and other word or numerical data—to be stored, sorted and printed in a variety of formats. The FlexFormat feature makes it easy to change, rearange and add unforeseen information to records, or combine business records into new files. This means that record keeping can adapt quickly as business information needs change. For example, the change from a five-digit to nine-digit zip code could be handled without rekeying al the data. Users may also create a "partial file definition" for fast data entry of specific portions of records. VisiFile is controlled by a "moving cursor menu" with prompting. Information entry is simple and allows the user to custom design a "form-like" format on screen for input. Machine language sorting routines and multiple keyed-field indexes assure information retrieval within three seconds. VisiFile runs on the Apple II (with language card or Applesoft Basic card) and Apple II Plus personal computers with 48K minimum memory and one disk drive; two disk drives and a printer are recommended. Price: $250. Personal Software, 1330 Bordeaux Dr., Sunnyvale, CA 94086, (408) 745-7841.
**CIRCLE INQUIRY NO. 243**

**Restaurant payroll system** is available for the TRS-80 models II and III, and for all CP/M microcomputers with addressable cursors, 80 by 24 screens, and 64K RAM. Features include: completely menu driven with extensive prompting for input; extensive input editing and validation checking to eliminate software crashes; accommodation for up to 250 active and 250 inactive employees; sick pay; bonus pay; input and worksheet reconciliation eliminates errors *before* paychecks are printed; and all employee data is easily modified at any time. Computant, Inc., 34 Lamplighter Dr., Manchester, CT 06040, (203) 646-0408.
**CIRCLE INQUIRY NO. 244**

**Financial modeling software** has virtual matrix capability. An expanded work area of 32,000 cells is available to accommodate the largest modeling tasks. That is equivalent to a 10-column model with 3200 rows or any other multiple of rows and columns that equals 32,000. Micro-DSS/Finance has all the power of large time-sharing systems. It runs on the Apple II with 64K and Pascal. Price: $1,500. Ferox Microsystems, 1701 N. Ft. Myer Dr., Suite 611, Arlington, VA 22209, (703) 841-0800.
**CIRCLE INQUIRY NO. 245**

**Tax aid program,** Tax/Saver features: optional text. It offers help for novices and speed for professionals, special screen formatting for easy data input, printout to video screen plus two types of printout to lineprinter, and full disk storage (with optional password protection) of data files. It compares all possible filing statuses in one run; compares itemized deductions to national averages; automatically computes certain limitations—for example, on medical deductions and contributions; checks for excess FICA; helps determine dependents. The program was developed for TRS-80 models I and III with 32K and two disk drives. Micromatic Programming Co., Box 158, Georgetown, CT 06829, (203) 544-8777.
**CIRCLE INQUIRY NO. 246**

**Medical management system,** Medicado, consists of a Cado 20/20 office information system programmed specifically for medical practices. It includes an appointment booking system, a patient information inquiry system, an automated procedures system, an automated patient recall system, and a financial reporting system. Each patient's file is maintained on the system, including up-to-date information on medication, treatment history, account status and next appointment date. Office personnel have immediate access to that information. Cado Systems Corp., 2771 Toledo St., Torrance, CA 90503, (213) 320-9660.
**CIRCLE INQUIRY NO. 247**

**Word processing program,** Writemaster, incorporates a completely novel command structure that approximates the flow of natural language. It provides commands and single key stroke functions that ease document creation. The program is capable of mail merging, index generation and many powerful text formatting functions. Additional features include: a complete menu system available in context by a single keystroke, a single keystroke user HELP command; automatic command input spelling correction; numerous single keystroke commands; complete file maintenance from within the program, and an emphasis on simplicity of operation at all levels. The package is available on 5 in. diskette (model #WRMR-S) or 8 in. diskette (model #WRMR-L). Price: $595. Cromemco, 280 Bernardo Ave., Mountain View, CA 94043, (415) 964-7400.
**CIRCLE INQUIRY NO. 248**

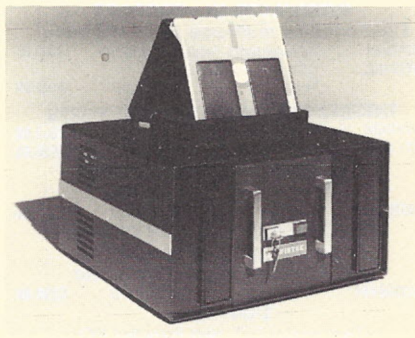
**Real estate office management** package is designed to provide accounting and management information for brokerage firms. It includes a general ledger that provides profit and loss statements, balance sheets, trial balances and transaction registers. The software allows users to generate profit and loss statements for multiple profit centers, divisions and offices. The package is designed to operate on any CP/M, MP/M or CP/Net system. Price: $350, including one year maintenance. REI, 221 North Lois, La Habra, CA 90631, (213) 947-2762.
**CIRCLE INQUIRY NO. 249**

**Text proofreader,** Disc-tionary, for CP/M systems can check a 30-page document for errors in less than two minutes. Each unrecognized word can be added, rejected, ignored, with a single key-stroke. After proofreading, the program leaves files containing the original unmarked text (BAK file), the marked text, and an alphabetized list of misspellings. Many options including automatic suffix removal are available. All functions are performed by a single menu-driven program for ease of use. CP/M, 8-in. drive(s) and 32K RAM are required. Price: $79. Stellarsoft Corp., 841 Blanchette Dr., East Lansing, MI 48823, (517) 332-2459.
**CIRCLE INQUIRY NO. 250**

**Multi-user operating system** delivers to the 8080/Z80 system user a full multi-user capability without the need for user patching or configuration. MultI/OS is designed to service up to sixteen simultaneous users, any of whom may run with a physical terminal or as a background job. It will support both floppy and hard disks with a shared data base of up to 975,000,000 bytes of on-line data. Each logical unit may be as large as 65M bytes, and the system will support multiple disk controllers without custom programming. Because of the huge amount of on-line data that can be accessed at one time, the system has an expanded directory capability that allows a virtually unlimited number of files. InfoSoft Systems, 25 Sylvan Rd. S., Westport, CT 06880, (203) 226-8937.
**CIRCLE INQUIRY NO. 251**

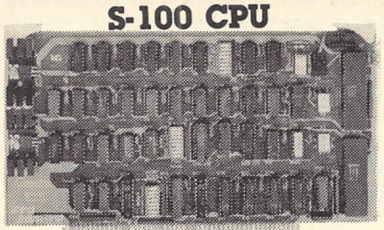
**Basic language compiler** for the TRS-80 models I and III is a business-oriented Basic language intended to be used as a development package for new software. It lets the user write a program in the popular and familiar Basic computer language, and provides the extra accuracy and speed many business applications require. The RSBasic development system includes full documentation and all software necessary to prepare and edit Basic programs, to compile programs and to execute these compiled programs. Price: $149. Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102.
**CIRCLE INQUIRY NO. 252**

**Full capability interpreter** with floating point, scientific functions, strings, and arrays of up to eight dimensions includes interactive syntax checking, command completion, file manipulations, user error processing, and 52 unique error messages. All versions are Basic source compatible,



but differ in the number of significant digits maintained during calculations with 7 digit to 64 digit accuracies available. Basic is supplied on diskette and intended to run on the Wintek Sprint 68 microcomputer/development system. Price: $95. Wintek Corp., 1801 South St., Lafayette, IN 47904, (317) 742-8428.
**CIRCLE INQUIRY NO. 255**

## S-100 CPU



**CPU-Z - GODBOUT**
2/4 MHZ Z80 CPU 24 Bit Addressing

| | | |
|---|---|---|
| GBT 160A | A&T | $199.00 |
| GBT 160C | CSC 3-6 MHZ | $375.00 |

**DUAL PROCESSOR 8085-8088 - GODBOUT**
6 or 8 MHz Provides true 16 Bit Power with a standard 8 bit S-100 bus.

| | | |
|---|---|---|
| GBT 1612A | A&T...6 MHZ | $399.00 |
| GBT 1612C | CSC...8 MHZ | $498.00 |

**SOLID STATE DISK DRIVE, 3500% FASTER!**
Not Really, But the Next Best Thing For Godbout 8085/88 Users. Call For Details on M-Drive. See Page 340 of November **BYTE**

| | | |
|---|---|---|
| GBT MD 128K | | $1550.00 |
| GBT MD 256K | | $3,000.00 |

**2810 Z80 CPU-CA. COMP. SYST.**
2/4 MHz Z80A CPU with RS232C Serial I/O Port complete with Monitor PROM for 2422 Disk Controller

| | | |
|---|---|---|
| CCS 2810A | A&T | $280.00 |

**CB2 Z80 CPU - S.S.M.**
2/4 MHZ will accept 2716, or 2732, or RAM RUN/STOP and single step switches

| | | |
|---|---|---|
| SSMCB2K | Kit | $260.00 |
| SSMCB2A | A&T | $310.00 |
| SSMZ80M | SSMZ80 Monitor | $89.00 |

**CBIA 8080 CPU - S.S.M.**
8080 CPU, 1K RAM, Holds 1 2708, 1 8 Bit parallel input port.

| | | |
|---|---|---|
| SSMCB1A | Kit | $183.00 |
| SSMCB1A | A&T | $225.00 |
| SSM8080M | SM 8080 Monitor | $59.00 |

## S-100 I/O BOARDS

**SYSTEM SUPPORT 1 - GODBOUT**
Serial port (software prog baud), 4K EPROM OR RAM provision, 15 levels of interrupt, real time clock, optional math processor

| PART NO. | DESCRIPTION | LIST PRICE | OUR PRICE |
|---|---|---|---|
| GBT162A | Assembled & Tested $39.00 | | $360.00 |
| GBT162C | CSC | $495.00 | $460.00 |
| GBT8231 | Math Chip | | $195.00 |
| GBT8232 | Math Chip | | $195.00 |
| GBT162AM1 | A&T with 8231 Math Chip | | $555.00 |
| GBT162CM1 | CSC with 8231 Math Chip | | $655.00 |
| GBT162AM2 | A&T with 8232 Math Chip | | $555.00 |
| GBT162CM2 | CSC with 8232 Math Chip | | $655.00 |

**MPX CHANNEL BOARD - GODBOUT**
I/O Multiplexer, using 8085a-2 cpu on board

| | | |
|---|---|---|
| GBT166A | Assembled & Tested $495.00 | $450.00 |
| GBT166C | CSC $595.00 | $550.00 |

**INTERFACER I - GODBOUT**
Two Serial I/O

| | | |
|---|---|---|
| GBT133A | A&T $249.00 | $219.00 |
| GBT133C | CSC $324.00 | $298.00 |

**INTERFACER II - GODBOUT**
Three parallel, one serial I/O board

| | | |
|---|---|---|
| GBT150A | A&T $249.00 | $219.00 |
| GBT150C | CSC $324.00 | $289.00 |

**INTERFACER III - GODBOUT**
Eight channel multi-use serial I/O board

| | | |
|---|---|---|
| GBT1748A | Assembled & Tested $699.00 | $629.00 |
| GBT1748C | CSC 200 hr. Burn In Test $849.00 | $629.00 |

**INTERFACER 3 WITH 5 SERIAL PORTS**

| | | |
|---|---|---|
| GBT1745A | Assembled & Tested $599.00 | $5[illegible]3.00 |
| GBT1745C | CSC 200 hr. Burn In $699.00 Test | $629.00 |

**MULTI I/O - MORROW DESIGNS**
Three Serial, Two parallel

| | | |
|---|---|---|
| MDSMB3200 | A&T $329.00 | $309.00 |

**SWITCHBOARD-MORROW DESIGNS**
Two serial I/O, four parallel I/O, one status port, one strobe port

| | | |
|---|---|---|
| MDSSB2411 | $259.00 | $239.00 |

**I/O4 - SSM**
Two serial I/O, two parallel I/O

| | | |
|---|---|---|
| SSMI04K Kit | | $210.00 |
| SSMI04A A&T | $290.00 | $260.00 |

**2710 4 PORT SERIAL - CCS**
4 Full handshaking RS232 ports and optional 2K ROM

| | | |
|---|---|---|
| CCS271001 | A & T $340.00 | $310.00 |

**2718 2 SERIAL & 2 PARALLEL - CCS**
2 RS232 C ports, 2 8 bit parallel ports, & optional 2K ROM

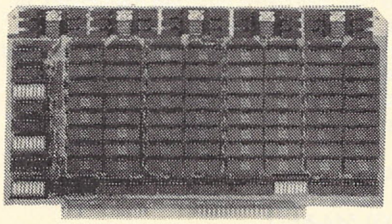
| | | |
|---|---|---|
| CCS271801 | A & T $360.00 | $325.00 |

**2720 4 PORT PARALLEL - CCS**
4 8 bit parallel ports and optional 2K ROM

| | | |
|---|---|---|
| CCS272001 | A & T $250.00 | $225.00 |

## S-100 10 MHZ STATIC RAM

**NEW LOW PRICES!**



**32K STATIC RAM - GODBOUT**
RAM 20 10 MHZ, 4Kbyte block disable, bank or 24 bit addressings available 8, 16, 24 or 32K

| PART NO. | DESCRIPTION | LIST PRICE | OUR PRICE |
|---|---|---|---|
| GBT164AA8 | 8K A&T | $210.00 | $190.00 |
| GBT164AC8 | 8K CSC | $280.00 | $260.00 |
| GBT164AA16 | 16KA&T | $285.00 | $260.00 |
| GBT164AC16 | 16K CSC | $355.00 | $325.00 |
| GBT164AA24 | 24K A&T | $355.00 | $325.00 |
| GBT164AC24 | 24K CSC | $425.00 | $385.00 |
| GBT164AA32 | 32K A&T | $425.00 | $385.00 |
| GBT164AC32 | 32K CSC | $495.00 | $450.00 |

**64K STATIC RAM - GODBOUT**
RAM 17, 10 MHZ, 2 Watt, DMA Compatable 24 Bit Addressing

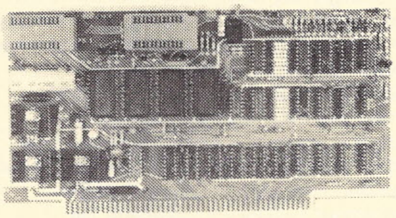
| | | | |
|---|---|---|---|
| GBT175A48 | 48K A&T | $650.00 | $619.00 |
| GBT175C48 | 48K CSC 200hr. | $750.00 | $710.00 |
| GBT175A64 | 64K A&T | $795.00 | $755.00 |
| GBT175C64 | 64K CSC 200hr. | $895.00 | $850.00 |

**NEW! 32K x 16 BIT STATIC RAM - GODBOUT**
RAM 16 10 MHZ, 32K x 16 or 64K x 8 IEEE/696 16 BIT 2 Watt, 24 Bit Addressing

| | | | |
|---|---|---|---|
| GBT180A | 64K A&T | $895.00 | $850.00 |
| GBT180C | 64K CSC | $995.00 | $945.00 |

**NEW! 128K STATIC RAM - GODBOUT**
RAM 21 10MHZ 128K x 8 or 64K x 16
IEEE/696 8 or 16 Bit 1.2 Amps 24 Bit Addressing

| | | | |
|---|---|---|---|
| GBT167A | 128K A&T | $1695.00 | $1610.00 |
| GBT167C | 128K CSC | $1895.00 | $1795.00 |



## S-100 ROM

**PBI PROM PROGRAMMER - SSM**
Programs 2708 or 2716's, operates as a 4K/8K EPROM BOARD AS WELL.

| | | |
|---|---|---|
| SSMPB1K | Kit | $179.00 |
| SSMPB1A | Assembled & Tested $265.00 | $220.00 |

**ECONOROM 2708 - GODBOUT**
16K x 8eprom Board using 2708, Power on jump to any 256 byte

| | | | |
|---|---|---|---|
| GBT125A | Assembled & Tested | $135.00 | $120.00 |
| GBT125C | CSC | $195.00 | $175.00 |

## S-100 VIDEO BOARDS

**SPECTRUM - GODBOUT**
Color Graphics board with Parallel I/O

| | | | |
|---|---|---|---|
| GBT144A | Assembled & Tested | $399.00 | $349.00 |
| GBT144C | CSC | $449.00 | $399.00 |
| GBT2D | Sublogic Universal Graphics Interpreter Software | | $35.00 |

**VB - 3 S.S.M.**
80 x 25 or 50 character video display Memory Mapped, Parallel Keyboard port

| | | | |
|---|---|---|---|
| SSMVB3K24 | 80x24 Kit | | $425.00 |
| SSMVB3A24 | 80x24 A&T | $499.00 | $440.00 |
| SSMVB3UP | 80x50 Line Upgrade | | $ 39.00 |

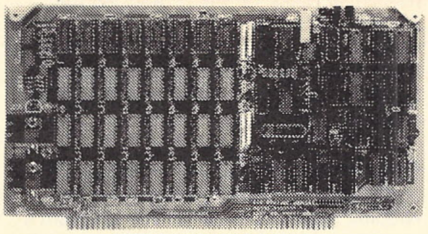
**VB2-S.S.M.**
I/O Mapped Video Board, with Parallel Keyboard port 64 x 16

| | | | |
|---|---|---|---|
| SSMVB2K | Kit | | $199.00 |
| SSMVB2A | Assembled & Tested | $269.00 | $229.00 |

**VBIC - S.S.M.**
Memory Mapped Video Board 64x16 character display or 64x16 graphics display

| | | | |
|---|---|---|---|
| SSMVB1K | Kit | | $199.00 |
| SSMVB1A | Assembled & Tested | $269.00 | $229.00 |

## S-100 DYNAMIC RAM

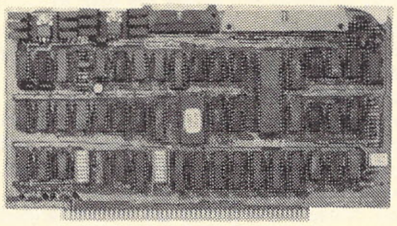


**THE EXPANDABLE 1**
**PRIORITY 1 ELECTRONICS**

THE EXPANDABLE 1" 64 K Dynamic Ram board provides your S-100 system with 64K of reliable, high-speed dynamic RAM. Compatable with most of the major S-100 systems on the market, including those with front panels, it supports DMA operations and requires no Wait states with current microprocessors. • User expandale from 16 to 64K • Supports DMA • Designed to IEEE proposed S-100 bus standards • 2 or 4 MHz operation • Operates with either an 8080 or Z-80 based S-100 system, providing processor-transparent refreshes with both • Supports IMSAI-type front panels • Jumper-selectable Phantom input • Uses Popular 4116 RAMS • All ICs in sockets • Any 16K block can be made bank-independent • Fully buffered address and data lines • Fail-safe refresh circuitry for extended Wait states • Board configuration with reliable, easy-to-configure Berg jumpers

| | | |
|---|---|---|
| PRIEXP116 | 16K Assembled & Tested | $299.00 |
| PRIEXP132 | 32K Assembled & Tested | $339.00 |
| PRIEXP148 | 48K Assembled & Tested | $379.00 |
| PRIEXP164 | 64K Assembled & Tested | $409.00 |

## S-100 DISK CONTROLLERS



**DISK 1 - GODBOUT**
FAST DMA, Soft Sector, Controls 8" or 5¼", single or double density OUR BEST!

| | | LIST PRICE | OUR PRICE |
|---|---|---|---|
| GBT171A | Assembled & Tested | $495.00 | $450.00 |
| GBT171C | CSC | $595.00 | $555.00 |
| GBTCPM80* | CP/M 2.2 for Z80/8085 with manuals & BIOS 8" S/D disk | | $175.00 |
| GBTOAS8S | Oasis 8 bit single user 8" S/D disk | | $500.00 |
| GBTOAS8M | Oasis 8 bit multi-user, 8" S/D disk | | $850.00 |

**2422A - CA. COMP. SYST.**
I/O Mapped, controls 8" or 5¼" single or double density A&T with CPM 2.2 8" S.D.

| | | |
|---|---|---|
| CCS2422A | $475.00 | $375.00 |

**DISK JOCKEY 2D - MORROW**
I/O Mapped, controls 8", single or double density, serial I/O

| | | |
|---|---|---|
| MDSDJ2208 | A&T with CP/M 2.2 $399.00 | $375.00 |

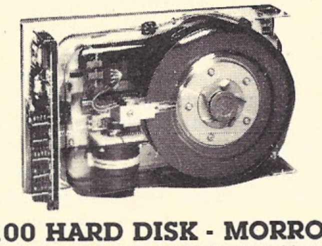
## S-100 DISK SUBSYSTEMS

**DISCUS SINGLE SIDED MORROW**
8" DBL Density drives with cabinet, power supply controller, with CP/M 2.2 and Microsoft Basic

| | | |
|---|---|---|
| MDSF1218 | Single Drive System 1095.00 | $950.00 |
| MDSF1228 | Dual Drive System $1875.00 | $1598.00 |

**DISCUS DOUBLE SIDED - MORROW**
8" DBL Density/sided drives with cabinet Power supply controller, with CP/M 2.2 and Microsoft Basic

| | | |
|---|---|---|
| MDSF2218 | Single Drive System 1395.00 | $1250.00 |
| MDSF2228 | Dual Drive System $2495.00 | $2050.00 |



## S-100 HARD DISK - MORROW

8" 10 & 20MB .14" - 26MB formatted hard disk complete with cainet, P.S., Controller, CPM 2.2 and Microsoft Basic

| | | LIST PRICE | SALE PRICE |
|---|---|---|---|
| MDSM10S | 10 MB | $3695.00 | $2950.00 |
| MDSM20S | 20 MB | $4795.00 | $3825.00 |
| MDSM26S | 26 MB | $4495.00 | $3495.00 |

# CALENDAR

**Feb 8-11 ACM Computer Science Conference,** Convention Center, Indianapolis, IN, aiding in matching computer scientists and data processing specialists with employment opportunities. ACM Computer Science Register, Dept. of Computer Science, U. of Pittsburgh, Pittsburgh, PA 15260.

**Mar 1-2 Michigan Assoc. for Computer Users in Learning Convention,** Western Michigan University, Kalamazoo, MI, presentations on various facets of educational uses of computers in addition to vendor presentations and displays. Oakland Schools, 2100 Pontiac Lake Rd., Pontiac, MI 48054, (313) 858-1898.

**Mar 16-18 Software/Expo-West,** Convention Center, Anaheim, CA, dealing with a wide range of applications from accounts payable to utilities. Terry Brooks, 222 W. Adams St., Suite 400, Chicago, IL 60606, (312) 263-3131.

**Mar 29-31 Information Utilities '82,** Rye Town Hilton Hotel and Conference Center, New York, NY, to focus on American videotex, transactional services, electronic publishing, online data bases for home use, copyright and censorship problems. Online, Inc., 11 Tannery Lane, Weston, CT 06883, (203) 227-8466.

**Apr 2-4 Eighty/Apple Computer Show,** Statler Exposition Hall, New York, NY, featuring exhibitors selling products and services related to the TRS-80 and Apple systems, including hardware, software, books, supplies and magazines. Also to feature seminars and technical sessions for both systems. Kengore Corp., 3001 Route 27, Franklin Park, NJ 08823, (201) 297-2526.

**Apr 4-7 Deltak International Training Conference/Access '82,** Hyatt Regency, Chicago, IL, will feature 35 workshop sessions with EDP trainees and professionals. Keynote speaker: Gerald R. Ford. Corporate Communications Assoc., 799 Roosevelt Rd., Building 6, Suite 315, Glen Ellyn, IL 60137, (312) 790-1225.

**Apr 13-14 Computer Network Performance Symposium,** University of Maryland, College Park, MD., focusing on theoretical and practical aspects of measuring and evaluating package-switch networks, computer vendors, network architectures and local area networks. Mitre Corp., W-701, 1820 Dolley Madison Blvd., McLean, VA 22102, (703) 827-6394.

**Apr 16-17 Virginia Computer Users Conference,** Marriott Inn, Blacksburg, VA, topics will include artificial intelligence, office automation, and data base management. Virginia Polytechnic Institute and State University Student Chapter, 562 McBryde Hall, Blacksburg, VA 24061, (703) 961-6931.

**Apr 21-28 Hanover Fair,** Hanover Fairgrounds, Hanover, West Germany, showcasing complete business communications systems, telex and facsimile equipment, telecommunications systems for distributed data processing networks, intercommunications systems plus radio and cable communications equipment. Hanover Fairs Information Center, Box 338, Whitehouse, NJ 08888, (201) 534 (800) 526-5978.

**Apr 22-25 New York Computer Show and Office Equipment Exposition,** Nassau Coliseum, Uniondale, Long Island, New York, will feature micro and mini computers for business, education, government, industry, home and personal use, including data and word processing equipment, office machines, computer peripherals and office supplies. National Computer Shows, 824 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000.

**Apr 27-29 Information Management Exposition & Conference for Manufacturing,** McCormick Place, Chicago, IL, is the only event in the information field devoted exclusively to manufacturing corporations. Clapp & Poliak, 245 Park Ave., New York, NY 10017, (212) 661-8410.

**May 4-6 Computer Graphics Conference and Equipment Display,** will consist of tutorials, presented papers, and an equipment display; takes a user's perspective on computer graphics. Rackham Memorial Building, 100 Farnsworth, Detroit, MI 48202, (313) 832-5400.

**May 4-6 Plant Engineering and Show/West,** Convention Center, Los Angeles, CA, will address plant engineering and maintenance problems that affect all types of manufacturing and processing plants, with special emphasis on companies operating in the West. Such industries as electronics, aerospace and defense will receive special attention. Clapp & Poliak, 245 Park Ave., New York, NY 10167, (212) 661-8410.

**May 11-14 Computer Aided Quality Show,** Inner Harbor Convention Center, Baltimore, MD, is dedicated to the application of mini, micro, and mainframe computers—as well as microprocessors and programmable controllers—to improve manufacturing quality. Technical sessions will cover testing and measurement, artificial intelligence, materials analysis, quality planning, dynamic measurement/adaptive controls, quality standards for software development, electronic circuit inspection, process controls, computer-human interface, and use of computer simulation for design/performance checking and verification. CAM-I, 611 Ryan Plaza Dr., Suite 1107, Arlington, TX 76011, (817) 265-5328.

**May 14-15 Southern California Computers-in-Education Conference,** University High School, Irvine, CA, will cover applications of computers from kindergarten through junior college, including reading, math, science, language, classroom management, school attendance, multicultural, special education, business education. Craig Walker, Arrowview, Intermediate School, 2299 North "G" Street, San Bernardino, CA 92405, (714) 886-9118.

**May 15-16 North American Computer Othello Championship,** Learning Resources Center, Anderson Hall, Northwestern U., Evanston, IL, will sponsor a two-day tournament to identify computer champions in three categories: microcomputer systems, mainframe systems, special-purpose Othello machines. Prof. Peter W. Frey, Department of Psycology, Northwestern University, Evanston, IL 60201.

**May 18-20 Northcon/82,** Seattle Center Coliseum, Seattle, WA, is a high-technology electronics convention and exhibition serving the Pacific Northwest region. Northcon/82, 999 N. Sepulveda Blvd., El Segundo, CA 90245, (213) 772-2965.

# BOOK REVIEWS

### How to Buy the Right Small Business Computer System
**by C. Roger Smolin**
**John Wiley & Sons, New York, NY**
*Reviewed by Robert Lyday*

This book is a well-written, easy-to-follow primer to information-processing systems. It is for the small businessman—not the home dabbler or games enthusiast (the vocabulary will only make sense to those familiar with standard business lingo).

The book starts off with the fledgling inventions of pioneers Eckert and Mauchley 35 years ago, and continues up through the latest developments in micros, with introductions to flowcharts and the primal system.

It also includes a nice up-to-date vendor chart detailing the top computer businesses (although the author admits it is incomplete since it leaves out Tandy, Apple and Xerox). There is a very basic introduction to the major languages, including Fortran, Cobol, Basic, DDP, ISAM and KSAM.

A viewpoint expressed by Smolin is that it was once near to impossible to get burned buying applications software, but now the chances are getting better and better. He advises the potential buyer to talk first with another owner of the system in mind, then to test it with one's own data, and finally to try to break the system via programming. He also relates an interesting anecdote about the industry—that computer personnel turnover is so high that almost no one stays on a job for more than two years. He states correctly that the under-rated importance of documentation cannot be stressed enough.

The final chapters deal with specific examples of software systems (including the tricky payroll program—a difficult one to write).

The book is stylistically adept for the genre, and the author's relaxed sense of humor holds him in good stead.
*156 pages $8.95*

### Computer Literacy: Problem-Solving with Computers
**by Carin E. Horn and James L. Poirot**
**Sterling Swift, Austin, TX**
*Reviewed by Leigh E. Zeitz*

Educators across the country have been clamoring for an easy-to-understand text for computer literacy classes. Teachers have had to contend with books that are either too technical or too childish in their approach. This text is ideal for an introductory computer class in junior or senior high school.

Written at an eighth-grade reading level, it provides a comprehensive overview of computers. The authors begin with an introduction to computer jargon and a brief history of computing. Then they address the importance of computers by showing everyday applications in the private and governmental sectors. The increasing number of computer-related occupations is also cited. This discussion is not limited to opportunities for computer operations personnel; it includes a survey of how computers are being used in existing professions.

The last three chapters are dedicated to building a fundamental understanding of flowcharting, programming and beginning Basic. The authors introduce the use of Basic commands in programming and list the differences in the forms of Basic used on microcomputers by Apple, Commodore, Tandy and Texas Instruments.

The book has been carefully organized as a teaching tool. Every chapter is filled with pictures and diagrams to facilitate understanding and is followed by a variety of pertinent questions and exercises. It ends with a glossary of over two hundred words and a nine-page bibliography.
*304 pages $13.95*

### 34 More Tested, Ready-To-Run Game Programs in Basic
**by Delton T. Horn**
**Tab Books, Blue Ridge Summit, PA**
*Reviewed by Dennis Doonan*

This book is an easy-to-use collection of game programs in Basic for the beginning programer or the home computer buff. Each game includes a complete description, flowchart, sample run and two program listings. The first listing is a standard Basic version that can be used on most home computers. The second version is in Radio Shack's TRS-80 level I Basic.

The games range from simple (based on random chance) to challenging (requiring strategy to play and win). None of the games use graphics due to a lack of standardization among the various machines available. While the appeal of commercial software is lacking, the games are easy to use; simple graphics can be added by the reader. Program development can be learned by the novice programmer if the listings and flowcharts are studied. By doing this, the reader will be able to modify the games and create new ones.

One-player games include such standards as Craps, High-low, Hangman and tic-tac-toe. Original games offer unique twists, such as "Freebish," where the player discovers the game's rules as he plays. There are several games for two players, and there are four versions of "Frustration."
*224 pages $7.95*

### Beyond Cobol: Survival in Business Applications Programming
**by Gary D. Brown**
**John Wiley, New York, NY**
*Reviewed by Rocky Smolin*

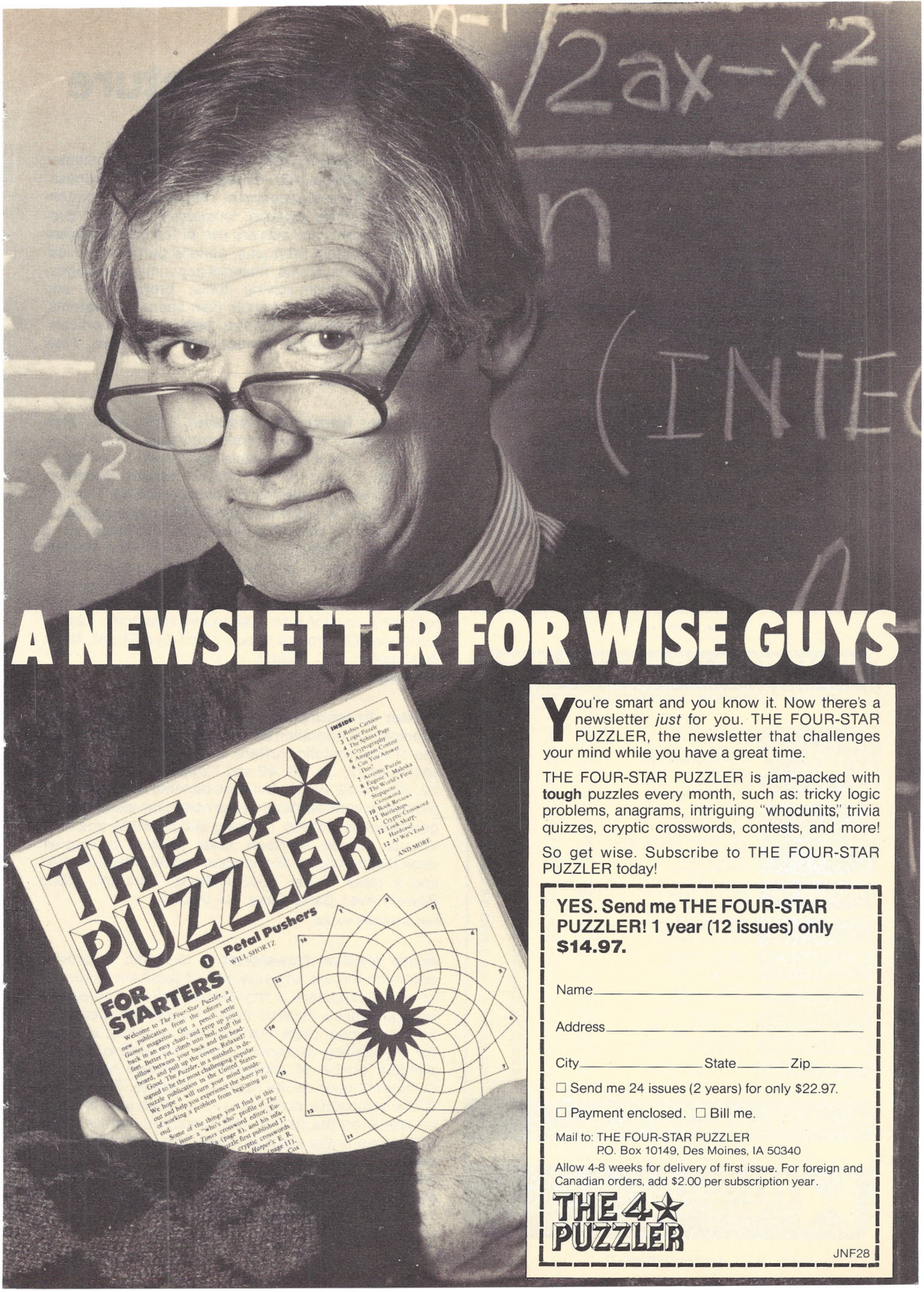
Brown's objective in this book is to give a preview of the work a Cobol applications programmer does. Many topics familiar to the computer science graduate—sequential and random access files, data base systems, sorting, reporting, and documentation—are covered. Brown's approach details these subjects as they appear in the cold reality of the business world. This type of insight is rare in programming books. It serves as an invaluable introduction for the entry-level programmer.

Brown's first topic is data in business applications—coding schemes for products, data string manipulations, accounting period problems and cost allocations. This is followed by a discussion of transactions and how to properly design and handle them. Another chapter is concerned with errors—how to detect, process, and avoid them. Throughout these first chapters, the examples and illustrations Brown uses all reflect his intimate knowledge of the business environment and the problems peculiar to Cobol applications systems.

Subsequent chapters discuss file structures and the techniques (primarily sequential and random access) for processing them. Chapter eight is an introduction to data base management systems and their vocabulary. Given the timeliness of this topic, more information here would have been appropriate, but what remains is concise and informative, giving the novice some familiarity with data base buzz words.

Two topics covered deserve mention. The first is documentation. The author shows how to recognize good documentation and what is expected in system-, program-, user- and run time-documentation. The second topic is maintenance—an unpopular job, but an important one.

This book is highly recommended reading for anyone about to enter the Cobol applications field.
*200 pages $17.50*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# Free Literature

**Software catalog** lists more than 200 computer programs available in 80 different formats for business, professional and personal use. The selection of system tools, telecommunications, languages and word processing systems and aids are part of the catalog, as are data management programs, general purpose applications, mail list systems, financial accounting packages, numerical problem-solving tools, professional and office aids, CP/M-compatible disk operating systems, hard disk integration modules, books and periodicals. Catalog #21, Lifeboat Assoc., 1651 Third Ave., New York, NY 10028.

CIRCLE INQUIRY NO. 201

**Consumer information booklet,** *Video—Your New Window On the World*, offers the consumer a full explanation of products available as "viewer controlled television," such as the video cassette recorder, videodisc player, satellite TV, cable and other forms of subscription TV. Major formats of VCRs (video cassette recorders) and videodisc players are explained, along with various features of the systems. The booklet contains 45 tips on getting the most from your VCR. A section on enjoying your video camera is included. Single copies are free to consumers sending a postage paid #10 envelope to: Electronic Industries Assoc./ Consumer Electronics Group, 2001 Eye Street, N.W., Washington, D.C. 20006.

CIRCLE INQUIRY NO. 202

**Plotter brochure** describes benefits, applications, principles of operation and specifications for complete line of electrostatic plotters. It covers models in paper widths of 22, 24, 36, 42 and 72 inches; film widths of 22, 36 and 42 inches. It details benefits of electrostatic plotters in such applications as computer-aided design, geotechnical plotting, mapping and business graphics. Visuals include fourteen color photos, a diagram depicting principles of operation, model selection chart and a table of key specifications. Versatec, 2805 Bowers Ave., Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 203

**Micro Medical Newsletter** is designed to provide advice on the use and selection of applications for use on microcomputers in the medical office. The current issue provides a detailed review of important accounting and insurance claim management systems available for the leading microcomputers. Included is an independent review of applications software running on computers such as the Apple II, Apple III, TRS-80 and CP/M compatible computers. The issue also includes an article on the use of minicomputers versus microcomputers in the medical office. It is available free to practicing physicians and other health professionals when a request is made on office stationery. Charles Mann & Assoc., Micro Medical Newsletter, 7594 San Remo Tr., Yucca Valley, CA 92284.

CIRCLE INQUIRY NO. 204

## Graphics Capabilities for the Small Business

*Continued from page 69*

integrated into a graphics system, the on-board microprocessor allows the terminal to operate without bothering the host computer, allowing graphics functions to be performed off line. Standard graphics primitive software includes basic graphics packages, such as drawing, erasing and complementing points, lines and rectangular regions. An individual point can be read and a light pen port is offered.

Screen resolution is 512 by 484 in the graphics format, and the text format is 39 lines by 85 characters. The keyboard is the IBM Selectric layout, and an RS-232 interface allows it to operate as a terminal with any host computer. Graphics systems software for multiline X-Y, contour and 3-D perspective plots, as well as pie and bar charts are available as Fortran callable subroutines to support DEC, Computer Automation, Alpha Micro and many CP/M-based microcomputers. The company also provides a dot matrix printer ($1,500) with a text output of 200 cps and a graphic raster resolution of 72 by 60 dots per in.

MQI Computer Products, Fountain Valley, CA, offers the Autograph series of terminals, featuring equivalent operation to the Tektronix 4010, one of the more sophisticated graphics terminals. The Autograph 120 ($2,390), one of the low end models, allows the use of alphanumerics along with graphics. The integral green phosphor screen is part of the Televideo 920 Terminal that MQI modifies for graphic applications.

The Autograph 120 uses Plot 10 or an optional business graphics package that operates under the CP/M operating system. Serial I/O is provided through an RS-232 or current loop port. The company offers companion printers to complete an entire graphics workstation for less than $4,000.

Ramtek, Santa Clara, CA, founded in 1971, introduced the first color graphics terminal for business in 1977. The company has been upgrading and expanding its product line ever since. One of the newer, low cost editions is the RM-6211 ($5,995) desktop terminal. The unit includes a detachable keyboard with six function keys. Host computer communication is provided via an RS-232 interface. The integral 13-in. monitor offers a resolution of 640 by 480 pixels operating at 30 Hz (interlaced). One of the many options available converts the resolution to 640 by 512 pixels operating at 60 Hz (repeat field). For applications where a large number of people will be viewing the same information, additional monitors can be daisy-chained through BNC connectors.

Four refresh memory planes permit the simultaneous display of up to 16 colors selected from a palette of 64. Ramtek's Colorgraphic Programming language (CGL) offers non-graphics users a powerful, easy-to-learn set of English language commands. The RM-6211 is compatible with the VT-100 Terminal, as well as the widely-used Tektronix Plot 10 graphics software.

A Centronics-compatible printer interface supports an optional colorgraphic printer. Other options include a light pen and a digitizing tablet for interactive input. Many other graphics products are available, including video display generators.

Vector Graphic, Thousand Oaks, CA, has taken a different approach to supporting graphic applications by providing an interface board for the S-100 bus. Graphit ($100) supports any Z80-based system with this high resolution graphics display board. The features allow a display of geometric shapes, erasing and toggling of points, lines, arcs and circles, plus the ability of plotting points. Dot resolution is 256 by 240, but provides no color capability, although a 16-level gray scale with 128 by 120 picture elements is provided. The output of the board is composite video conforming to the RS-170 levels. An input option supports a video digitizer that is provided on a separate S-100 board. Graphic output is provided to a printer port for use with the Epson printer. For S-100-based systems, this is a convenient and inexpensive approach to adding graphics capability.

### Hard copy output

In addition to the various graphic terminals used for input verification and temporary display, there are a multitude of graphic printers and plotters for permanent viewing. The hard copy peripherals range in price from $785 up to about $7,500 for more sophisticated applications.

Many, if not most, of the dot matrix printer manufacturers offer graphic feature options to allow reproducing business graphics. One low cost example from Micro Peripherals (MPI), Salt Lake City, UT, is the model 88G ($800), which offers graphics output in addition to a single sheet feeder. For color output, the more expensive units like the Xerox 6500 color graphics printer or the Trilog Colorplot 100 printer can be used. The thing to remember about some of the dot matrix printers is that, even though graphics can be represented, there is a limited resolution. Of course, since they are printers, they do double duty for all printed output.

For special applications where much better resolution is required, a graphic plotter may be necessary. Hewlett-Packard, Palo Alto, CA, offers a line of plotters, such as the HP-9872C ($5,300) with as many as eight different pens on a single plot. Radio Shack, Fort Worth, TX, has just introduced a six-pen plotter ($1,995) with an RS-232 interface. Houston Instruments, Austin, TX, manufactures a line of printer/plotters for microcomputer applications. The DMP-7 (IA Dec 81) provides 8½ by 11-in. plotting for $1,085 with an option ($395) to upgrade to six colors.

Strobe, Inc., Mountain View, CA, offers probably the lowest cost ($785) high quality color graphic plotter. The Strobe 100, when interfaced to an optional controller board for the Apple II ($85), S-100 bus ($145), TRS-80 model I ($110) or Commodore Pet ($110), provides multicolor graphics with .004-in. resolution. The company supports the plotter with a Plot Application program ($70), allowing graphics mixed with alphanumerics. A business package for the Apple II is also available.

One other type of hard copy output is in the form of photographic film. Of course, anyone can take photographs of the CRT/TV screen, but it usually looks like a photograph of a TV screen.

Image Resource, Westlake Village, CA, produces neither a graphics terminal nor any graphics products; the company manufactures a unique video print system. The self-contained unit provides a convenient method of reproducing high quality full color photographic copies of anything that can be displayed on a graphics system. The model 3400 ($4,490) provides an RS-170

RGB input with manual front panel controls. The model 3100 ($4,690) provides composite video input from many of the small business computers or other video sources. The model 3500 ($4,790) combines the two features into a single unit with switch selectable input.

Optional film systems for the unit include SX 70, or 4 by 5 film holder ($890 each) or a 35mm film system ($1,250). If a large number of slides or other color-graphic material are required for brochures, seminars or other presentations, this can be an efficient and cost-effective approach for the generation of full color photographs.

## Graphics software

As with any computer application, software is frequently the key to a useful and convenient operation. With graphics this is probably even more important, since many of the applications intended for small business computers did not include graphics applications.

A number of graphic products to support small business applications are available. Some will support only black and white terminals, while others offer full color presentations. With the integration of some of the graphics terminals presented above, a complete graphics system (including color graphics capability) can be incorporated into most small business computers. When deciding on the software package required for your application, there are a number of parameters that need to be evaluated, and hopefully the products listed here will give you some ideas as to the areas to be evaluated when selecting a particular software product. Many of the software packages listed will support only one type of computer system, but just about any of the small business computers will support some sort of graphics application.

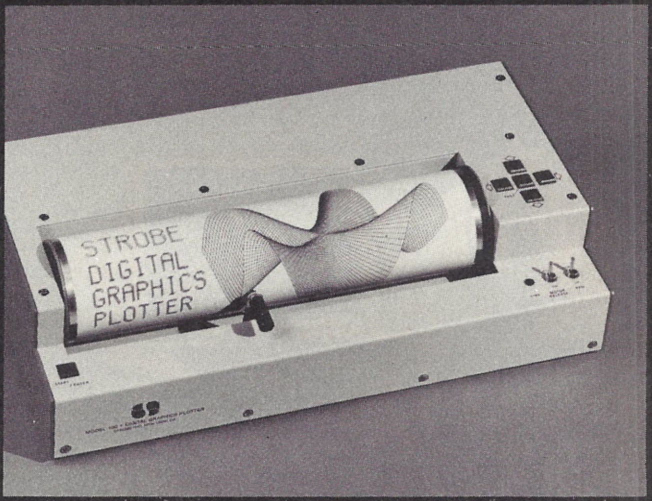
According to Gene Sprouse, President of Rainbow Computing, Northridge, CA, one of the areas to consider when selecting a graphics package for business applications includes the ability for the graphics package to interface with other types of software; specifically, for statistical applications with programs such as VisiCalc. He also indicates that the abilities to scale charts up and down, label axis and add text to the charts are some of the significant features that should be available. For more complex operations, curve smoothing, moving averages and the ability to use regressions to spot trends would be valuable. Few, if any, of the graphics packages will support all of the desirable features, but it may be helpful to choose the one that optimizes your particular requirements. Since we highlight only a few of the numerous graphics programs here, it's wise to discuss your particular application with someone knowledgeable regarding routines available for your computer system. In any case, ask for a demonstration of the program you intend to purchase.

Some of the programs listed, while not truly business graphics packages, are used to illustrate the capabilities available with some of the computer systems in terms of graphic support.

Apple Computer, Cupertino, CA, offers a number of graphics packages to take advantage of the Apple II's high resolution monochrome and color capability. Besides games, there are practical applications for the color capability on the Apple computer.

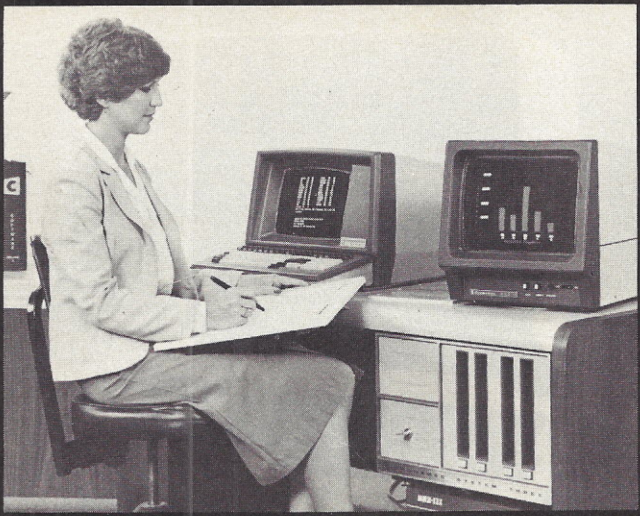
With the Supermap program, geography can be made more enjoyable and capitals more captivating as

***Datamedia Color Scan 10***

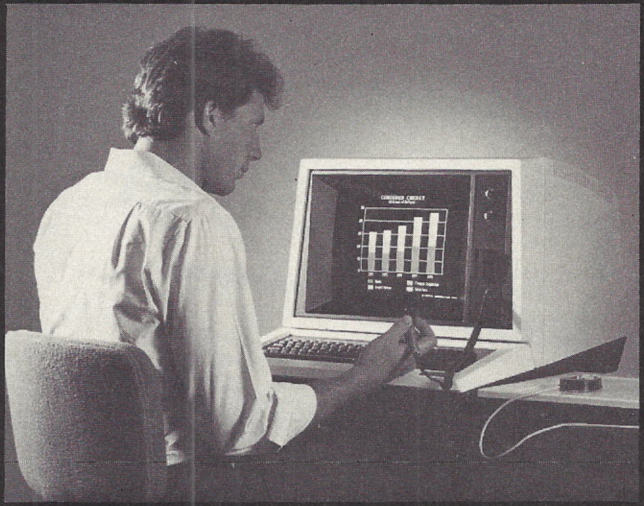



***Strobe 100 low cost plotter***

***Columbia Data Products' Commander 900***



***Cromemco Business System***



***Ramtek RM-6211 Colorgraphics Terminal***

we study the Continental United States. Over 300 cities with four full color maps are provided. The most important facts include zip code, population, longitude and latitude. Supermap will also display the distance between any two cities and highlight the location of 300 cities. While the program can be used effectively to teach U.S. Geography, it can also be used for determining routing of materials between cities in the United States.

Artist Designer by Howard Ganz (see article on page 74) is an exciting opportunity for artists to draw and paint virtually any colorgraphics composition they wish. The color monitor or television screen becomes the canvas, with the game paddles becoming the paint brushes. The program produces irregular shapes, curves and other forms as defined by the artist and color dots can be filled in to defined areas to introduce textures. In addition to black and white, green, yellow, orange, violet and red can be mixed to produce hundreds of color tints, mixtures and shades. Up to 3,500 finished or in-progress compositions fit on a single storage diskette.

With this program, several designs can be linked together so that a composition can be built piece by piece, or slide shows can be created for presentations where large screen TVs are available for the audience to review. Twenty pre-drawn designs are included, which can be modified or used as your own compositions. The menu-driven software makes it easy for anyone to learn to draw.

Utopia Graphics Tablet System is probably one of the most popular software products to support Apple's graphics tablet. The expanded capabilities offer features and convenience typically found only on larger graphic systems. A wide variety of brush types for creating original shapes and functions plus 64 color options can generate 40 unique brush shades. The menu-driven software has programs to help design patterns, charts, graphs and animated screens, as well as a digitizer option that allows calculation of distances and area on any shape traced on the graphics tablet.

The program author, recording artist and record producer Todd Rundgren, has developed some extraordinary graphics programs for the system's various menus. The highly interactive system is supported through the pen-controlled cursor without menu overlays or keyboard commands. In addition to the software package, the Apple graphics tablet is also required as an additional peripheral.

With the versatile software package, Topographic Mapping, information can be presented with three-dimensional realism. It allows the user a most effective way of displaying any type of information that varies continuously with location, such as climatological trends, mathematical functions or engineering models. Apple's high resolution graphic capabilities provide accurate and useful information, even in three dimensions. A map can be re-drawn from different points of view to locate the right prospective.

There are actually nine topographic mapping programs and seven types of displays in the software package. Each one is selected from a main menu. While color is available from some of the low resolution programs, five black and white displays exploit the high resolution graphics capability of the system. Demonstration files are included to assist the operator in becoming familiar with the graphics programs.

Cromemco, Mountain View, CA, offers Slidemaster ($595), with multiple design capabilities through its menu-driven set of commands. The 75 powerful commands offer the first time user a convenient means of generating and modifying graphic material. As the name implies, this is a convenient program to generate slides required for effective presentations or illustrations and even includes a slide changer feature with a TV display for multiple slides. The program supports a digitizer input and provides a resolution of 756 by 482 dots on a high quality RGB monitor. Up to 16 colors can be generated with a RGB monitor, and outputs can be provided to plotters or video outputs using a standard RS-170 format.

Slidemaster operates on the Cromemco Z2H-GS system running under the CDOS operating system. A related program, Fontmaster, provides ten different fonts and electronic symbols for incorporation into any displayable material, including graphs generated with Slidemaster. It even allows the addition of special user symbols.

Datasoft, Northridge, CA, offers Micro-Painter ($35), which operates on both the Apple II and the Atari 800 microcomputer systems. Through the use of game paddles, the user creates images on the color screen. This allows a wide variety of color graphic operations, with up to 21 colors available on the Apple computer. The program also allows the selection of color at any individual pixel and has a microscope feature that expands the original picture to seven times the original size.

Muse Software, Baltimore, MD, features Dataplot ($60), supporting the high resolution capabilities of the Apple II. It also has the ability to create and modify a wide variety of color graphic representations, including bar and pie charts. In addition, statistics for each of the represented graphics can be displayed automatically.

Personal Software, Sunnyvale, CA, offers VisiPlot ($180). When combined with VisiCalc, this program offers a fairly sophisticated graphical and statistical package in one unit. Line graphs and bar graphs can be combined in one diagram, a feature not always available with some of the other software products discussed. VisiPlot also supports color presentations, and even includes grid lines for easy graph interpretation.

Versa Computing, Newbury Park, CA, offers numerous software packages, as well as the VersaWriter, a digitizer drawing board and software system that allows quick entry of graphics information to the Apple II high resolution screen. The unit even exceeds the accuracy of Apple's hi-res screen. It plugs into the Apple II game I/O port, and provides a useful drawing area of 8 in. by 12½ in. As the pointer on the drawing arm is moved to outline the drawing, a picture appears immediately on the video screen. Simple one-letter mnemonics are used to command the VersaWriter software.

The VersaWriter was used to generate all pictures in Meet the Presidents, a new software packages offered by Versa. While Meet the Presidents is really not a useful graphics package, it is perhaps one of the best demonstrations of the artistic capabilities of the Apple II. The 39 original full color computer graphic portraits were drawn by computer artist Sol Bernstein (IA Dec 79). The educational program operates by gradually revealing a presidental portrait, while suggesting a clue as to the identity of the president. Points are tallied for the player's speed in identifying the presidents. Or the slide show portion will display the presidents without the quiz game. A significant feature of the slide show operation is the refresh rate at which the pictures are shown on the screen.

The quality of the images demonstrate the capability of the VersaWriter in generating all types of color graphics and artistic material. It would certainly support any of the business applications requiring the use of color graphics.

Hopefully, this overview of graphics and the look into the choices will provide a good indication of what's available. Of course, the use of graphics is not for everyone. It could be used for many more applications, but it isn't necessary to make up an application just to get into graphics. Evaluate the choices; determine how graphics can help; then get a demonstration of some of the graphics packages. Talk to knowledgeable salespeople before you invest in a graphics system. Above all, remember that the field of video graphics isn't just a game. □

*Continued from page 73*

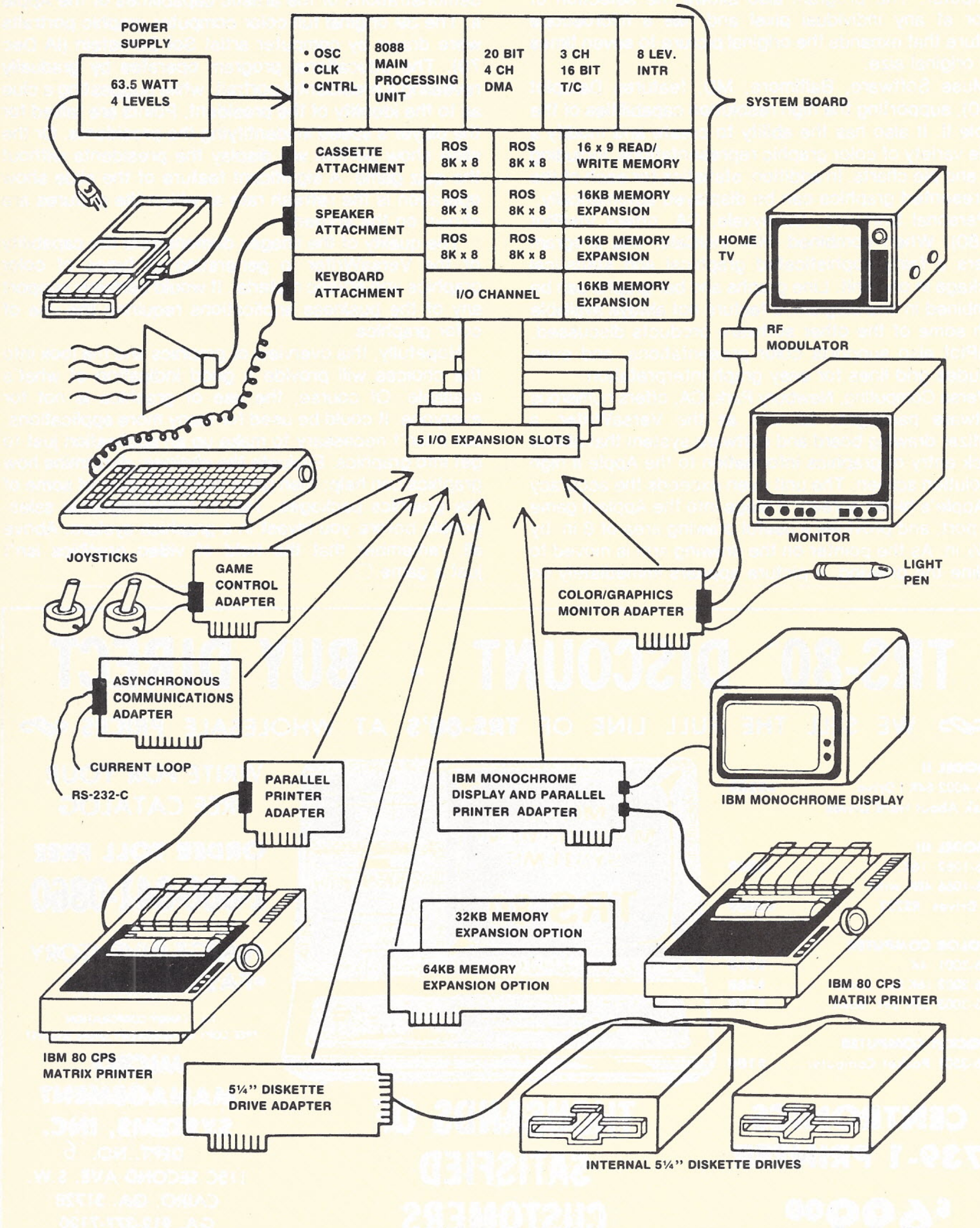



**Figure 1. Components of the IBM Personal Computer**

up to five adapter cards and a tightly sealed power supply. The power supply is of the switching type (as opposed to a linear design), minimizing power consumption and heat buildup problems. The computer's only cooling fan is a built-in part of the power supply itself. It is arranged to pull cool air through the computer's front openings, over and around the various electronic components, then push it through the power supply and out the rear of the machine. This arrangement buries the fan deep within the enclosure, substantially quieting its whisper.

Perhaps the most carefully designed portion of the main circuit card is the input/output (I/O) expansion capability. This takes the form of five identical 62-pin connectors, which will accept the gold-plated edges of accessory plug-in daughter circuit cards. The design of this bus—surely destined to be called the IBM bus—has a lot in common with Intel's Multibus. This sounds reasonable, since both cater to the I/O needs of the 8086/8088 microprocessor device. The electrical, mechanical and timing specifics of this bus are well defined and published by IBM in a move to encourage other manufacturers to offer compatible plug-in cards. IBM itself has given the industry a good start, with no fewer than eight such cards available right away. Let's take a look at each of these cards, which IBM calls adapters.

**Surprisingly, the lowest cost system is achieved by the color-capacity version...**

One of the first choices to make is whether you want a color or monochrome (literally "single color") display capability. A different adapter is required for each. The ramifications of the monochrome/color decision are far-reaching, as we shall see. Surprisingly, the lowest cost system is achieved by the color-capability version of the computer—but here's the catch: *you* provide the TV set for the display. To do this, order the color/graphics monitor adapter. This card includes the circuitry necessary to drive an external color monitor or TV set. The adapter is compatible with studio-quality red/green/blue (RGB) monitors, as well as the composite video kind, often utilized with home video tape recorders. An external radio frequency (RF) modulator is necessary if the system is to display through an ordinary TV set.

The quality of the picture varies quite a bit among the three choices. The best (and most expensive) display comes with an RGB monitor. Computer dealers will like the fact that the color adapter is capable of driving a TV set and RGB monitor at the same time. This opens the door for large-screen demonstrations and training classes.

The color/graphics monitor adapter contains 16K bytes of RAM utilized exclusively to refresh the video picture 30 times each second. This allows a resolution of 64,000 picture elements (pixels), arranged 320 across by 200 down. This is termed the medium resolution mode. Each pixel can be one of four colors; it takes special software to combine the color dots if a greater number of hues is needed. The programmer's task for allocating a color to a given pixel sounds complex at first, but it provides the kind of flexibility necessary for more advanced functions. A pixel can be one of 16 internally pre-defined colors, or one of three colors assigned by the user as a part of a three-color palette. Two such palettes can be defined separately, and the whole screen switched almost instantly from one palette to the other.

The color/graphics monitor adapter also supports high-resolution displays. This is a monochrome mode—only two colors can be defined on the screen at once: black and white, purple and yellow, or whatever is needed for the application. Double the resolution is offered in this mode: 640 pixels across by 200 down.

The multi-talented color adapter also includes the circuitry needed to support a light pen. This is a device that allows you to point to the screen to indicate a precise position to a computer program.

If your needs don't include color computing, you can opt for the monochrome display and parallel printer adapter. As its name indicates, it combines two functions in one: displaying and printing. The display portion is intended to drive IBM's monochrome display,

| COMPUTER | | PROCESSOR | | | SOFTWARE | | BENCHMARK RUN TIME |
|---|---|---|---|---|---|---|---|
| MANUFACTURER | MODEL | TYPE | BITS | SPEED | OPERATING SYSTEM | LANGUAGE | |
| IBM | Personal Computer | 8088 | 8/16 | 4.0 MHz | DOS | Advanced Basic | 838 sec |
| Hewlett-Packard | HP125 | Z80A | 8 | 3.7 MHz | CP/M | Basic/125 | 916 sec |
| Radio Shack | TRS-80 model II | Z80A | 8 | 4.0 MHz | TRSDOS 1.1.2 | Level III Basic | 955 sec |
| Apple | Apple II + | 6502 | 8 | 2.0 MHz | DOS 3.2 | Applesoft II Basic | 960 sec |
| Commodore | CBM | 6502 | 8 | n/a | DOS on ROM | Microsoft Basic | 1159 sec |
| IBM | 5120 | n/a | n/a | 1.9 MHz | n/a | Basic | 1956 sec |
| Zenith | Z89 | Z80 | 8 | 2.0 MHz | HDOS | Microsoft Basic | 2027 sec |

**Figure 2. IBM Meets the Prime Number Cruncher**
The industry giants compared via our Prime Number Cruncher benchmark. (See IA Aug 81 for test program.) All except the 5120 use Microsoft's Basic interpreter.

although monitors carrying other nameplates will likely work as well.

The monochrome adapter contains a 4K-byte refresh RAM. These comprise just twice as many bytes as there is room for characters on the screen. The extra byte for each character is put to good use: it contains information regarding the attribute of each character. An attribute is something like reversed video, half intensity, blinking or underlined character. All of these are supported by the IBM system.

The two display adapters share several common characteristics. They will both produce 25 lines on the screen, each line containing either 40 or 80 characters each. The 40-character display is intended for the RF modulator/TV set application, as an 80-character line would be fuzzy to the point of unreadability on these narrow-bandwidth devices. The display adapters generate each character within a 9 by 14 dot matrix, far more precisely than the ordinary computer screen. The chosen typefont is a pleasing one featuring bookface-style serifs.

The selection of displayable letters, numbers and special characters is enormous. A full set of 256 characters is offered, complete with several foreign language letters, including most of the Greek alphabet. Graphics characters are included for constructing forms or large mathematical symbols on the screen. If desired, the clever programmer can re-define 128 of the characters to be anything that can be drawn within the 9 by 14 matrix. Graphics and character modes may be intermixed, allowing legends to be displayed on graphs and pictures.

Since both of the display adapters contain on-board dual-port refresh memories, they operate the screen displays in what is called the memory mapped mode. This is a far faster way of displaying data than the more common serial mode. The faster speed is dramatically apparent in an application such as graphics animation or, for that matter, a busy word processor. Several microcomputer manufacturers have forsaken the speed advantages of memory mapping because of the penalty that had to be paid in reduced memory address space. This problem doesn't exist for the IBM unit however, since the 8088 microprocessor CPU has an uncommonly large memory addressing range.

**Adapter interface is necessary**

If your system needs a printer, it also requires an adapter card to handle the electrical interface to that device. This is the parallel printer adapter. The device contains a fairly standard Centronics-style parallel interface arrangement. It plugs right into the IBM printer offered with the Personal Computer, of course, and should work as well with any other printer containing a standard parallel interface. The adapter is needed only if your computer is equipped with color/graphics monitor adapter. The monochrome adapter has its own version of the printer circuitry on this card.

The 5¼ in. diskette drive adapter is, to date, the only piece of hardware available for connecting disk drives to this computer. It is intended primarily for connection to the internal diskette drives in the system unit. Actually, the diskette adapter is using only a fraction of its capabilities when it does this. The heart of this adapter is an NEC μPD765 single-chip floppy disk controller. The 765 is capable of communicating with either 5¼ in. or 8 in. diskette drives in single- or double-density modes, and handling of single- and double-sided diskettes.

The 765 floppy controller has the ability to address up to four separate diskette drives at the same time. The IBM engineers had the foresight to bring the interfacing circuitry of the diskette adapter out to a rear panel connector. It's sure to be only a matter of time before outboard disk drives are available, whether from the company itself or other vendors.

Once the memory slots on the system board are filled to their limit with 64K bytes of RAM, extra memory must be fitted on an adapter card. IBM offers two varieties, a 32K-byte memory expansion option and a 64K-byte memory expansion option. This provides the system with a total of either 96K bytes or 128K bytes of user-available memory for programs and data. First, it should be noted that this computer is remarkable in allowing *any* memory greater than the traditional 64K bytes. Again, we must thank the designers of the 8088 microprocessor; the chip has the capability to address up to 1M byte of memory. This means that all of the memory fitted to the system can be devoted to a single user (the *only* one in this case). Other manufacturers' methods of extending RAM capability beyond 64K bytes often involve fragmenting it so that it is unusable all at once.

***The simple selection of "color or not" is an important one***

The asynchronous communications adapter is the system's window to the serial communications world. Although intended for interfacing to the telephone network via a modem, this adapter will also connect to a local serial printer, terminal or graphics plotter. The EIA RS-232C protocol is observed by this device, with current loop interfacing available if needed. The asynchronous communications adapter opens up the world of public data bases such as The Source. In addition, it allows Personal Computers to commune with an internal network of "office of the future" workstations.

Finishing the list of plug-in cards is the game control adapter. This is a simple device for connecting a pair of external paddles, joysticks or tracking ball hand controllers. Klingon-zapping "fire" buttons are supported, too. Far from being mere toys, analog hand controllers have serious applications in the field of data analysis via graphics computing.

If the array of adapter cards is impressive, the corresponding collection of connectable peripherals is disappointingly brief. Only one terminal screen is offered: a monochrome one with green and black display. The diskette drives, as we've mentioned, are limited to two—and they're pretty small ones at that. Finally, there's a single variety of printer: a small dot matrix unit. And that's the end of the list. All other hardware accessories must be obtained outside of the IBM circle. That includes the cassette recorder, color display, its RF modulator (if needed), light pen, game

paddles and modem. Such items are (or are soon sure to be be) readily available from a host of independent manufacturers eager for your business. Each must be supported by the appropriate enabling software, so make such purchases with care.

Even though the list is short, the quality of hardware peripherals selected for this IBM product can hardly be faulted. The IBM monochrome display, for example, produces a crisp green image ranking with the best to be found in any data processing center. The display is a compact unit only 11 in. high by 15 in. wide. It's just two inches short of being as deep as the system unit, and weighs in at 17 pounds. Other than its having only a single color, the monochrome display falls short of a multi-color unit in two areas important to graphics applications: the high-resolution mode is not available, and the light pen won't work. Light pens need precise timing information to locate a spot on the screen, and the P39 phosphor used in IBM's single-color display has too long a persistence for that.

So the simple selection of "color or not" is an important one. If the choice is color, there is much facility here for graphics creativity. Adding a printer to this, however, requires an extra-cost adapter. Opting for the monochrome route casts the system in a more business-like role. Graphics capabilities are constrained, but the essential printer interface comes with the bargain.

The diskette drives form the target for the bulk of the criticism leveled at this computer's design. In a word, they're small. Floppy disks currently come in two sizes; IBM chose the smaller of them. Floppies are also available for single- or double-sided use; IBM chose single-sided ones. Finally, floppies can be had in single- or double-density format. In this case, IBM went for the more modern high-density units. Total capacity is a mere 160K bytes per diskette. When you consider the power available with its advanced 8/16-bit microprocessor and the generous capacity offered in RAM, the machine seems unbalanced. It could certainly make good use of more disk storage.

Although the diskette drives might look just like similar units in other computers, they're really special in performance. For example, IBM has tightened up the read/write head access time to a maximum of 8 mS track-to-track. This is up to three times faster than other, similar drives.

## Printer is another asset

The only printer available with the unit is IBM's privately labeled version of the Epson MX-80. We have seen the MX-80 rise meteorically in popularity ever since its introduction less than two years ago. This is certainly due to its extremely low cost as much as its advanced features, of which few applications programs take full advantage. The printer is a dot matrix impact unit with a moving printhead. The latter characteristic puts the printer in the serial category—not to be confused with its electrical interface, which is parallel.

Up to 80 characters can be printed each second, and the printhead is capable of forming the characters while moving backward as well as forward. Several enhanced printing modes are available to provide a darker, more typewriter-like image. These tricks, however, take their toll in printing speed: up to a 75% penalty must be paid for pretty copies. The MX-80 also contains a foreign-language character generator and a special set of graphics symbols that have more in common with those seen in Radio Shack's TRS-80 model I than the IBM unit.

For what it does, the printer is very small: 16 in. wide, 15 in. deep and just 4 in. high. Weighing only 12½ pounds, the little chatterbox sits nicely on IBM's optional printer stand. This is an elegantly simple structure molded from a single sheet of smoked sheet plastic. It's tiny, but has adequate room for at least a day's supply of fanfold paper. The paper, incidentally, must be no wider than 8½ in. That's enough to squeeze in a full 132 columns of computer printout, using a special compressed print mode.

## Keyboard design is important

Think about it: at what point are you the most intimately in contact with your computer? That's an easy one—it's the keyboard. When you touch a computer, it's probably on the keys. While you aren't looking at the screen, you're probably gazing upon engraved keycaps. If a computer manufacturer is to do anything properly, we are told, it had better be with the keyboard design.

Volumes could be written about designing keyboards, as indeed they have. A sizeable portion of them were authored by IBM engineers, industrial designers and psychologists. You look for something special from a research leader, and we prepared ourselves to expect a great deal from the keyboard when we first approached they system. We weren't even a little bit disappointed.

First off, it's detachable. Leashed with a generous six feet of coiled cable, the keyboard is free to be located in the most convenient place on a cluttered workspace. Second, it's uncommonly thin—only two inches tall at the rear; considerably lower where the keys themselves reside. This allows the keyboard to be placed comfortably on a table that's just too tall for a typewriter or ordinary computer terminal.

The keyboard module is a full 20 in. wide and 8 in. deep, with room for 83 keys. At six pounds, the unit is astonishingly heavy—we almost dropped the first one we picked up. We suspect that this is deliberate. A keyboard that remains stationary while the fingers roam over the keytops is sure to reduce typing errors. The design also features a pair of feet that can be extended to tilt the keys toward you. We can't imagine why IBM included this gimmick, as it places the key plane at an unnaturally steep angle. You'll use it once, then stow the little legs forever.

The keys are arranged in the now-famous Selectric dished curve. Each key resists finger pressure with a satisfying spring action that releases suddenly at the bottom. This tactile feedback, along with a gratifying "click," confirms that the stroke was properly registered in the computer. All keys have the "typamatic" feature —they repeat endlessly if held down for more than a half-second or so.

The 26 English alphabetical keys are there, of course, along with 10 number keys and a generous collection of punctuation characters. The right-hand dozen or so keys are given over to a calculator-style 10-key pad with supporting mathematical operators. This area also controls the screen's cursor movement with left, right, up, down and home keys overlaying the numerals. A NUM LOCK key shifts the function between the numeric and cursor control modes.

Two rows of 10 keys at the left are programmable for various functions. They might be used to make menu selections in an accounting program, or for text editing activities in a word processor—it's up to the programmer. When Basic is invoked, these keys are assigned common meanings such as LIST, RUN, GOSUB, etc. The functions performed by these keys may be re-assigned quite easily, and the new meanings displayed on the bottom (25th) line of the screen.

It's true of any computer: the fanciest hardware features are utterly wasted if they aren't supported by a good software package. IBM, of all companies, is not one to neglect such an important area. Since the dawning days of computing, the company has built its success by providing well thought-out software solutions to business problems. The current offering is no exception.

The unit breaks a lot of long-held company traditions. Perhaps the most remarkable departure is that the software was created by outside vendors. In fact, every major program offered has been available for some time from various commercial sources.

The operating system, for example, began life as 86-DOS under the banner of Seattle Computer Products. Microsoft has adapted it extensively for IBM, integrating into it a version of its widely-used Basic interpreter. Software Art's VisiCalc is by now a familiar business planning program; and Information Unlimited's EasyWriter word processor is, if not a household word, a respectable example of its type. Peachtree Software provided three of its major accounting packages: general ledger, accounts receivable and accounts payable. The addictive, labyrinthine game of Adventure is rooted deep in computer lore. Microsoft adapted this version of the game, as well as a Pascal compiler. Soon to be available are the CP/M-86 operating system and the UCSD Pascal environment by Digital Research.

### Bug catchers at work

It's an astounding collection, really, for a brand-new computer. Some say IBM took the lazy way out by not developing the programs internally. The fact is, however, that IBM programmers have indeed worked hard, spending many thousands of hours with these programs during the past year or so. What were they doing? Looking for bugs, mostly. "If it carries the IBM name, it has to be *right*," says the company management. The workers took heed, and the effort paid off. We are told that lots of tiny errors, undetected for years, were ferreted out of programs many of us have been running all along. Even if the system fails utterly as a product, IBM will still be remembered for its cleanup of a major chunk of the world's microcomputer software.

While all of these programs were apart on the operating table, they were overhauled considerably to take advantage of the system's most distinctive features. Keyboard operations, for example, have been standardized, and the 10 programmable function keys utilized where appropriate. VisiCalc now speaks with two separate "beep" tones to indicate different kinds of entry errors. Other examples abound.

Programmers in Microsoft Basic will be delighted to hear that the traditional primitive line editor has been replaced with a sophisticated full-screen text editor, usable during program development. It's a little like that found on Hewlett-Packard's HP 85 or the IBM 5120, but much, much easier to handle. While we're talking about Basic, we should mention that it supports the full use of the computer's color graphics capabilities, as well as seven octaves of sound control. Music can be generated in musician's terms (A-flat, legato, etc.)—not the arcane language of audio engineers. Although limited to single tone, or voice, music can be created in a pseudo-background processing mode, so that it plays simultaneously with CPU-intensive tasks like graphics animation. Hardware interrupts are supported, so a Basic program can respond instantly to joystick or light pen inputs.

### Two operating systems offered

Any computer's most important program is its operating system. IBM has two, one for the diskless cassette-based machine and one that supports the pair of floppy diskettes. The latter is simply called DOS, for disk operating system. It's very CP/M-like in its appearance to the operator, but has a great number of "big machine" features added to it. The system has a time and date function, and the disk files are automatically date-stamped when changes are made. There's a simple line editor, which is always active while entering DOS commands. The utilities are powerful and friendly to the user. COPY is PIP-like in that it supports wildcard filenames, and allows the copying of files to and from odd devices such as the keyboard.

The cassette-only operating system is contained entirely within the computer's 20K bytes of ROM; no "boot-up" is necessary. The disk operating system, when added, makes full use of those ROM capabilities to minimize RAM requirements. This allows the important utilities of COPY, DIR, ERASE, RENAME and TYPE to be entirely memory-resident—they will work even if a system diskette is not installed in one of the drives.

DOS is self-adjusting; it makes full use of whatever memory is physically installed in the processor. When only a single disk drive is fitted, it reverts to a single-drive COPY mode, prompting the user to change disks when necessary to perform a backup. With two drives fitted, a disk-to-disk backup can be performed in a speedy 31 seconds.

The development of DOS is ongoing. Microsoft has stated that future releases will sport some very UNIX-like features. UNIX is that *wunderkind* operating system developed by Bell Laboratories that is one of the real challengers to succeed CP/M as the next "standard" microcomputer operating system. This competition has a new contendor, by the way: the IBM DOS just described.

"Ongoing" is a good word to end on. We think it's significant that the cadre of 250 developers at Boca Raton was not dismantled when the new system entered its production phase. You just *know* they're all in the back rooms diligently working on next year's announcements. Couple this with the independent plug-compatible industry that is gearing up to support IBM's new baby, and we smell an explosion brewing. It will soon be raining little computers with IBM nameplates. Rush out with your umbrella upside down and catch one for your own. □

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## Game Corner
*Continued from page 25*

GAME CORNER

**Program listing**

```
11070 REM     FOR TRS-80 MODEL I, LEVEL II
11080 REM FOG INDEX ANALYSER.  KEY IN TEXT AND HIT "ENTER"
11090 CLEAR 1000:CLS:PRINT@0,CHR$(95);
12000 DIMW$(600):N=0:FLAG=0:SYL=0:WRD=0:BIG=0:SEN=0:DIMC$(20)
12005 REM "VOWELS"
12010 DATA "A","E","I","O","U","Y"
12020 FOR I=0 TO 5:READV$(I):NEXT I
12025 REM "CONSONANTS"
12030 DATA "B","C","D","F","G","H","J","K","L","M","N","P",
"Q","R","S","T","V","W","X","Z"
12040 FOR I=1 TO 20:READ C$(I):NEXT I
12045 REM GET WORDS FROM KEYBOARD
12050 I$=INKEY$:IF I$=""GOTO 12050
12060 W$(N)=I$:PRINT@N,W$(N);:N=N+1:PRINT@N,CHR$(95);
12070 IF I$<>CHR$(13)GOTO 12050 ELSE W$(N-1)=" "
12075 PRINT "DATA ENTERED"
12080 FOR J=0 TO N:PRINT@J,CHR$(191);
12085 REM LOOK FOR VOWELS
12090 FOR K=0 TO 5
12100 IF W$(J)=V$(K) FLAG=1:GOTO 12150
12110 NEXT K
12115 REM LOOK FOR CONSONANTS AND COUNT SYLLABLES
12120 FOR K=1 TO 20
12130 IF W$(J)=C$(K):IF FLAG=1 SYL=SYL+1:FLAG=0
12140 NEXT K
12145 REM END OF WORD? CHECK IF >3 SYLLABLES
12150 IF W$(J)=" " WRD=WRD+1:IF SYL>=3 BIG=BIG+1:
PRINT@1000,BIG;:SYL=0:FLAG=0 ELSE SYL=0:FLAG=0
12155 REM END OF SENTENCE? COUNT SENTENCES
12160 IF W$(J)="."OR W$(J)="!"OR W$(J)="?"OR W$(J)=":"
 SEN=SEN+1
12165 REM SHOW WHERE TEST IS BEING DONE
12170 PRINT@J,W$(J);:NEXT J
12175 REM COMPUTE FOG INDEX
12176 REM 0.4 TIMES (SENTENCE LENGTH + % OF BIG WORDS)
12180 FOG=.4*((WRD/SEN)+(BIG/WRD)*100):PRINT
12190 PRINT SEN;" SENTENCES  ";WRD;" WORDS  ";WRD/SEN;
" WORDS PER SENTENCE  "
12200 PRINT BIG;" BIG WORDS  ";BIG/WRD*100;
" % WORDS WITH 3 OR MORE SYLLABLES"
12210 PRINT "FOG INDEX=";FOG
12220 END
```

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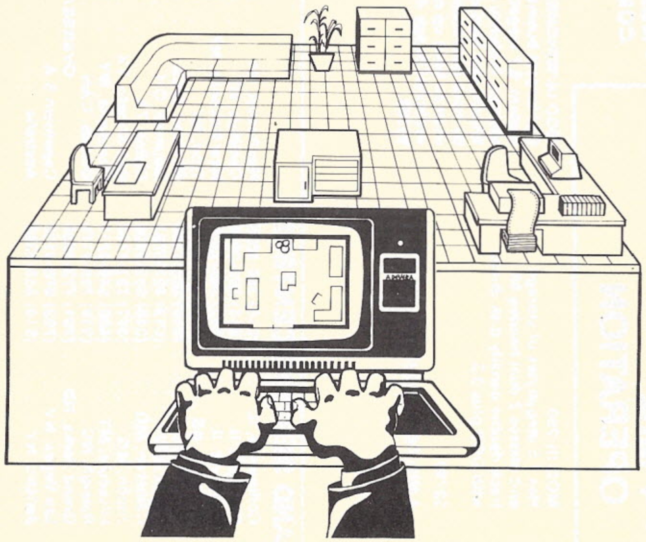
## Drafting Your Office Floor Plan
***Continued from page 81***



### Variables used in program

| | |
|---|---|
| A$ | Keyboard character input through INKEY$ routine |
| CAB$ | Graphics character representing a file cabinet |
| CHAIR$ | Graphics characater representing a chair |
| DESK$ | Graphics character representing a desk |
| F | Factor indicating what portion of a foot per pixel |
| FLAG | Flag indicating direction of last cursor movement |
| P | Position of cursor |
| P$ | CHR$(43), a crosshair. |
| R | Value used to change POKE value to PRINT @ value. |
| R$ | A space, CHR$(32), used to rubout graphics |
| S$ | String of ten spaces |
| T | Number of pixels in current movement series |
| TBL$ | Grapahics character representing a table |

```
330 :      FLAG=9:F=2
340 :      GOTO 220

350 :   ' ****** MOVE CURSOR LEFT ******

360 :      IF A$<>CHR$(8) GOTO 440
370 :      PRINT @ 48,S$;
380 :      IF FLAG=9 GOTO 220
390 :      X=X-1:IF X<1 X=1:PRINT @ 48," LIMIT !";
400 :      IF FLAG<>8 THEN T=0 ELSE T=T+1
410 :      FLAG=8:F=2
420 :      GOTO 220
430 :   ' ****** MOVE CURSOR DOWN ******

440 :      IF A$<>CHR$(10) GOTO 520
450 :      PRINT @ 48,S$;
460 :      IF FLAG=91 GOTO 220
470 :      Y=Y+1:IF Y>40 THEN Y=40:PRINT @ 48," LIMIT !";
480 :      IF FLAG<>10 THEN T=0 ELSE T=T+1
490 :      FLAG=10:F=.85
500 :      GOTO 220

510 :   ' ****** MOVE CURSOR UP ******

520 :      IF A$<>CHR$(91) GOTO 220
530 :      PRINT @ 48,S$;
540 :      IF FLAG=10 GOTO 220
550 :      Y=Y-1:IF Y<3 THEN Y=3:PRINT @ 48," LIMIT !";
560 :      IF FLAG<>91 THEN T=0 ELSE T=T+1
570 :      FLAG=91:F=.85
580 :      GOTO 220

590 : ' ****** PLACE FURNITURE IN ROOM ******

600 :      PRINT @ 896,"(D)ESK :  ";DESK$;"  (F)ILE:  ";CAB$;
           "  (C)HAIR:  ";CH$;"  (T)ABLE : ";TBL$;
610 :      PRINT @ 0,"USE @ KEY TO CONTROL VERTICAL DESK AND TABLE
           R TO RUBOUT"
620 :      IF PEEK(P)=32 POKE P,43
630 :      A$=INKEY$:IF A$="" GOTO 620
640 :      IF A$=CHR$(64) VFLAG=1:GOTO 630
650 :      IF A$="R" PRINT @ P-R+1,R$;:PRINT @ P-R+3,R$;:GOTO 620
660 :      IF PEEK(P)=43 POKE P,32

670 :    ' ****** MOVE CURSOR RIGHT ******

680 :      IF A$<>CHR$(9) GOTO 730
690 :      IF PEEK(P+1)<>32 GOTO 620
700 :      P=P+1:POKE P,43
```

| | |
|---|---|
| V2$-V3$ | Graphics characters used in building vertical objects. |
| VDESK$ | Graphics character representing a vertical desk |
| VFLAG | Indicates that next item printed should be vertical |
| X | Horizonal axis |
| Y | Vertical axis |

**Program listing**

```
10  CLEAR 4000
20 ' ****** DEFINE  VARIABLES AND GRAPHICS CHARACTERS ******

30 :     F=2
40 :     X=1:Y=3
50 :     P=15428
60 :     R=15362
70 :     F$="##.##"
80 :     S$=STRING$(10,32)
90 :     R$=STRING$(1,32)
100 :    DESK$=STRING$(5,191)+CHR$(149)
110 :    VDESK$=STRING$(3,191)
120 :    V2$=STRING$(3,131)
130 :    V3$=STRING$(3,176)
140 :    CAB$=CHR$(143)+CHR$(133)
150 :    CH$=CAB$+CHR$(133)
160 :    TBLE$=STRING$(6,191)
170 :    P$=CHR$(43)

180 ' ****** DRAW ROOM ******

190 :     CLS
200 :     PRINT @ 1,"HIT <EN> WHEN DONE DRAWING";
210 :     GOTO 250
220 :     SET (X,Y)
230 :     PRINT @ 32,"      ";
240 :     PRINT @ 32,"";:PRINT USING F$;T/F;:PRINT @ 39,"FEET";
250 :     A$=INKEY$:IF A$="" GOTO 250
260 :     IF A$=CHR$(13) GOTO 600

270 :  ' ****** MOVE CURSOR RIGHT ******

280 :       IF A$<>CHR$(9)GOTO 360
290 :       PRINT @ 48,S$;
300 :       IF FLAG=8 GOTO 220
310 :       X=X+1:IF X>125 X=126:PRINT @ 48," LIMIT !";
320 :       IF FLAG<>9 THEN T=0 ELSE T=T+1
```

```
710 :       GOTO 620

720 :  ' ****** MOVE CURSOR LEFT ******

730 :     IF A$<>CHR$(8) GOTO 780
740 :      IF PEEK(P-1)<>32 GOTO 620
750 :     P=P-1:POKE P,43
760 :      GOTO 620

770 :  ' ****** MOVE CURSOR DOWN ******

780 :     IF A$<>CHR$(10) GOTO 830
790 :      IF PEEK(P+64)<>32 GOTO 620
800 :      P=P+64:POKE P,43
810 :      GOTO 620

820 :  ' ****** MOVE CURSOR UP ******

830 :     IF A$<>CHR$(91) GOTO 880
840 :    IF PEEK(P-64)<>32 GOTO 620
850 :     P=P-64:POKE P,43
860 :     GOTO 620

870 :  ' ****** PRINT DESK ******

880 :      IF A$<>"D" GOTO 980
890 :      IF VFLAG<>1 GOTO 950
900 :      PRINT @ P-R,VDESK$;
910 :      PRINT @ P-R+64,V2$;
920 :      PRINT @ P-R-64,V3$;
930 :      VFLAG=0
940 :      GOTO 620
950 :      PRINT @ P-R,DESK$;
960 :     GOTO 620

970 :  '****** PRINT FILE CABINET ******

980 :      IF A$<>"F" GOTO 1010
990 :      PRINT  @ P-R,CAB$;:GOTO 620

1000 :  ' ****** PRINT TABLE ******

1010 :     IF A$<>"T" GOTO 1070
1020 :     IF VFLAG<>1 GOTO 1060
1030 :     PRINT @ P-R,VDESK$;
1040 :     PRINT @ P-R+64,VDESK$;
1050 :     VFLAG=0:GOTO 620
1060 :     PRINT @ P-R,TBL$;:GOTO 620
1070 :     IF A$<>"C" GOTO 620
1080 :     PRINT @ P-R,CH$;:GOTO 620
```

## Create Chain Files Automatically

*Continued from page 108*

### Program listing

```
1 '*****************************************************
  *                                                   *
  *                                                   *
2 '*                CHAIN WRITER                       *
  *                                                   *
  *                                                   *
3 '*                                                  *
  *****************************************************

100 CLEAR 2000
110 DIM I(30),B$(30),A(30),C$(30)
120 CLS
130 PRINT @ 204,"THIS PROGRAM CREATES A CHAIN PROGRAM"
140 PRINT @ 268,"TO BE USED BY NEWDOS/80 CHAIN COMMAND"
150 PRINT @ 458,"INPUT FILESPEC  OF CHAINFILE TO BE CREATED"
160 PRINT @ 586,"<< USE STD. FILESPEC CONVENTION & DRIVE >>"
170 PRINT @ 725," ?";
180 LINE INPUT A$
190 IF LEN(A$)<1 THEN 170
200 GOSUB 600

210 ' ****** ENTER UP TO 30 LINES OF CHAIN FILE ******

220 :  FOR I = 1 TO 30
230 :    PRINT @ 589," LINE #";I;"OF CHAIN PROGRAM :"
240 :    PRINT @ 652,"<<  ENTER DOS, BASIC, OR SPECIAL COMMAND >>"
250 :    PRINT @ 720,"(ENTER E TO END - S TO START OVER)"
260 :    PRINT @ 834,"? ";
270 :    LINE INPUT B$(I)
280 :    IF LEN(B$(I))<1 THEN 260
290 :    IF B$(I)="E" THEN 340
300 :    IF B$(I)="S" THEN 100
310 :    GOSUB 600
320 :  NEXT I

330 ' ****** CREATE, OR ADD TO DISK FILE ******

340 CLS
350 OPEN "E",1, A$
360 :  FOR A=1 TO I-1
370 :    D=LEN(B$(A))
380 :    IF LEFT$(B$(A),1)<>"!" GOTO 420
390 :    C$=RIGHT$(B$(A),D-2)
400 :    PRINT #1,CHR$(128)+C$
410 :    IF A=<I-1 THEN NEXT A
420 :    IF LEFT$(B$(A),1)<>"#" GOTO 460
430 :    C$=RIGHT$(B$(A),D-1)
440 :    PRINT #1,CHR$(129)+"** PRESS ENTER TO CONTINUE. **"+C$
450 :    IF A=<I-1 THEN NEXT A
460 :    IF LEFT$(B$(A),1)<>"$" GOTO 500
470 :    C$=RIGHT$(B$(A),D-1)
480 :    PRINT #1,CHR$(130)+C$
490 :    IF A=<I-1 THEN NEXT A
500 :    IF LEFT$(B$(A),1)<>"%" GOTO 540
510 :    C$=RIGHT$(B$(A),D-1)
520 :    PRINT #1,CHR$(131)
530 :    IF A=<I-1 THEN NEXT A
540 :    IF A=<I-1 THEN PRINT#1, B$(A): NEXT A
550 CLOSE
560 CLS
570 PRINT @ 461,"CHAINFILE ";A$;" HAS BEEN CREATED"
580 END

590 ' ****** PRINT SPECIAL COMMANDS AVAILABLE TO SCREEN ******

600 CLS
610 PRINT @ 10,"<< LIST OF SPECIAL COMMAND CHARACTERS >>"
620 PRINT @ 128,"! - ENTER TO BEGIN A NEW CHAIN SECTION"
630 PRINT @ 196,"(ENTER ! THEN A SPACE - THEN NAME OF SECTION)"
640 PRINT @ 256,"# - TO INSERT NOTES IN CHAIN FILE. WILL AWAIT ENTER TO CONTINUE"
650 PRINT @ 320,"$ - TO INSERT NOTES PRINTED WITH NO PAUSE "
660 PRINT @ 384,"% - TO INSERT NOTES NOT DISPLAYED WHEN CHAIN FILE RUNS"
670 PRINT @ 453,"<< ENTER NUMBER - THEN A SPACE - THEN DESIRED NOTES >>
680 PRINT STRING$(64, 140); STRING$(63, 32)
690 RETURN
```

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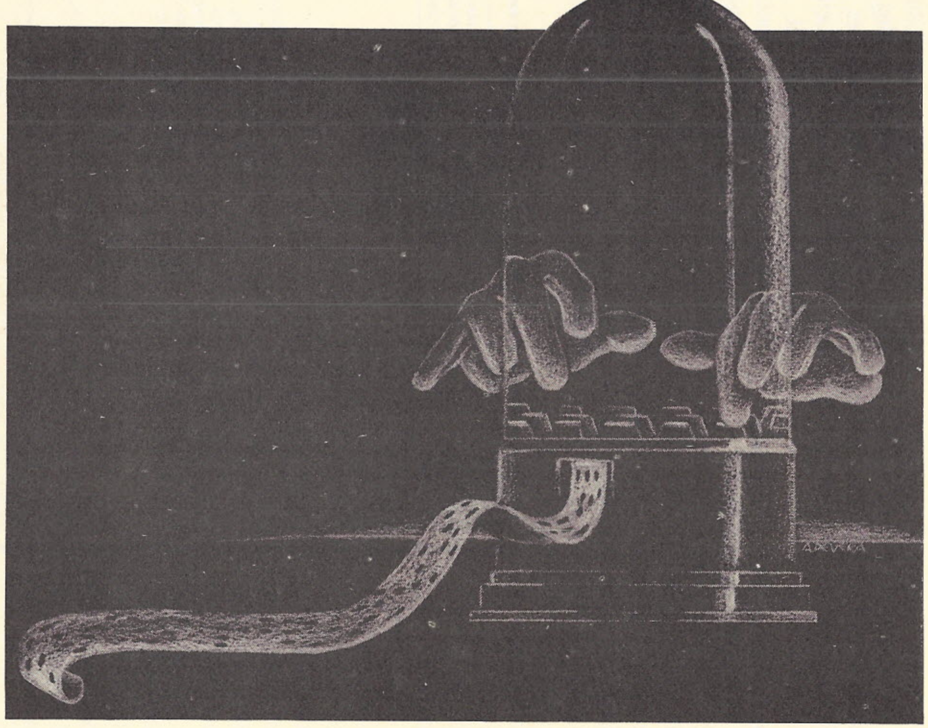
## Easy Keying of Stock Market Data

*Continued from page 114*



### Program listing

```
       INPUT-OUTPUT SECTION.
       FILE-CONTROL.
           SELECT  MASTER-FILE-IN   ASSIGN TO DISK
                   ORGANIZATION IS LINE SEQUENTIAL
                   FILE STATUS MASTER-FILE-IN-STATUS.
       DATA DIVISION.

       FILE SECTION.
       FD  MASTER-FILE-IN
           VALUE OF FILE-ID STOCK-INPUT-NAME
           LABEL RECORD STANDARD.
       01  MASTER-IN-RECORD                    PIC X(79).

       WORKING-STORAGE     SECTION.
       77  EDIT-IN                             PIC X(12).
       77  EDIT-OUT                            PIC 9(6)V9(5) VALUE ZEROS.
       77  ERROR-CODE                          PIC X         VALUE SPACE.
           88  VALID-RETURN-CODE                             VALUE ' '.
           88  EDTPRICE-RETURNED-ERROR                       VALUE 'E'.

           10  F   PIC X(34) VALUE 'GF      GENERAL FOODS             '.
           10  F   PIC X(34) VALUE 'GM      GENERAL MOTORS            '.
           10  F   PIC X(34) VALUE 'GT      GOODYEAR                  '.
           10  F   PIC X(34) VALUE 'N       INCO                      '.
           10  F   PIC X(34) VALUE 'IBM     INTNL BUSINESS MACHINES'.
           10  F   PIC X(34) VALUE 'HR      INTNL HARVESTER           '.
           10  F   PIC X(34) VALUE 'IP      INTNL PAPER               '.
           10  F   PIC X(34) VALUE 'JM      JOHN MANSVILLE            '.
           10  F   PIC X(34) VALUE 'MRK     MERCK & CO                '.
           10  F   PIC X(34) VALUE 'MMM     MINNESOTA MINING & MFG '.
           10  F   PIC X(34) VALUE 'OI      OWENS-ILLINOIS            '.
           10  F   PIC X(34) VALUE 'PG      PROCTER & GAMBLES         '.
           10  F   PIC X(34) VALUE 'S       SEARS, ROEBUCK & CO       '.
           10  F   PIC X(34) VALUE 'SD      STANDARD OIL OF CALIF     '.
           10  F   PIC X(34) VALUE 'TX      TEXACO INC                '.
           10  F   PIC X(34) VALUE 'UK      UNION CARBIDE             '.
           10  F   PIC X(34) VALUE 'X       US STEEL                  '.
           10  F   PIC X(34) VALUE 'UTX     UNITED TECHNOLOGIES       '.
           10  F   PIC X(34) VALUE 'WX      WESTINGHOUSE ELECTRIC     '.
           10  F   PIC X(34) VALUE 'Z       WOOLWORTH, (F W)          '.
           10  F   PIC X(34) VALUE HIGH-VALUES.
           10  F   PIC X(34) VALUE HIGH-VALUES.
           10  F   PIC X(34) VALUE HIGH-VALUES.
           10  F   PIC X(34) VALUE HIGH-VALUES.
           10  F   PIC X(34) VALUE HIGH-VALUES.
           10  F   PIC X(34) VALUE HIGH-VALUES.
           10  F   PIC X(34) VALUE HIGH-VALUES.
           10  F   PIC X(34) VALUE HIGH-VALUES.
           10  F   PIC X(34) VALUE HIGH-VALUES.
           10  F   PIC X(340) VALUE HIGH-VALUES.
           10  F   PIC X(340) VALUE HIGH-VALUES.
           10  F   PIC X(340) VALUE HIGH-VALUES.
           10  F   PIC X(340) VALUE HIGH-VALUES.
           10  F   PIC X(340) VALUE HIGH-VALUES.
           10  F   PIC X(340) VALUE HIGH-VALUES.
           10  F   PIC X(340) VALUE HIGH-VALUES.


       01  STOCK-SELECTION REDEFINES STOCK-TABLE.
           10  ONE-STOCK OCCURS 120 INDEXED BY STK-TBL-INDEX.
               15  STOCK-SYMBOL           PIC X(8).
               15  STOCK-DESCRIPTION      PIC X(26).

       01  CONSOLE-INPUT-AREA.
           10  STOCK-HIGH                         PIC X(12).
           10  STOCK-LOW                          PIC X(12).
           10  STOCK-CLOSE                        PIC X(12).

       01  CONTROL-AREAS.
           10  STOCK-TABLE-SWITCH                 PIC X     VALUE ' '.
               88  STOCK-TABLE-IN-USE                       VALUE '1' '2'.
               88  STOCK-TABLE-RESTARTING                   VALUE '2'.
               88  STOCK-TABLE-NOT-FOUND                    VALUE '3'.
               88  USER-DONE                                VALUE 'E'.
           10  MENU-TYPE                          PIC X.
               88  END-RUN                        VALUE '0' 'E'.
               88  RESTART-YES                    VALUE 'Y' 'S' 'R'.
           10  RESTART-SYMBOL                     PIC X(8) VALUE SPACES.
           10  STOCK-CARDS-IN                     PIC 9(5) VALUE ZEROS.
           10  MASTER-FILE-IN-STATUS              PIC XX    VALUE '99'.
               88  MASTER-FILE-IN-EOF                       VALUE '10'.
               88  MASTER-FILE-NOT-OPEN                     VALUE '99'.
```

```
       COPY C:STOCKINP.CBK.
       01  STOCK-INPUT-RECORD.
           10  RECORD-ID                       PIC X(3).
               88  STOCK-FORMAT                VALUE 'STK'.
           10  TRADE-DATE                      PIC 9(6).
           10  SETTLEMENT-DATE                 REDEFINES TRADE-DATE.
               15  TRADE-MONTH                 PIC 99.
               15  TRADE-DAY                   PIC 99.
               15  TRADE-YEAR                  PIC 99.
           10  SECURITY-SYMBOL                 PIC X(8).
           10  HIGH                            PIC 9(6)V9(5).
           10  LOW                             PIC 9(6)V9(5).
           10  CLOSING                         PIC 9(6)V9(5).
           10  STOCK-VOLUME                    PIC 9(9).
           10  FILLER                          PIC X(21).

       COPY C:STKTABLE.CBK.
       01  STOCK-TABLE.
           10  F  PIC X(34)  VALUE 'ACD        ALLIED CHEMICAL           '.
           10  F  PIC X(34)  VALUE 'AA         ALUMINUM CO. OF AMERICA'.
           10  F  PIC X(34)  VALUE 'AMB        AMERICAN BRANDS           '.
           10  F  PIC X(34)  VALUE 'AC         AMERICAN CAN              '.
           10  F  PIC X(34)  VALUE 'T          AMERICAN TELEPHONE        '.
           10  F  PIC X(34)  VALUE 'BLY        BALLY MFG                 '.
           10  F  PIC X(34)  VALUE 'BS         BETHLEHEM STEEL           '.
           10  F  PIC X(34)  VALUE 'DD         DU PONT                   '.
           10  F  PIC X(34)  VALUE 'EK         EASTMAN KODAK             '.
           10  F  PIC X(34)  VALUE 'XON        EXXON                     '.
           10  F  PIC X(34)  VALUE 'GE         GENERAL ELECTRIC          '.
```



```
               88  MASTER-DID-OPEN                     VALUE '00'.
           10  STOCK-INPUT-NAME.
               15  IN-DRIVE                  PIC XX    VALUE 'C:'.
               15  IN-NAME                   PIC X(8)  VALUE 'STKINPUT'.
               15  IN-EXTENSION              PIC X(4)  VALUE '.DAT'.

       PROCEDURE  DIVISION.
       GET-INPUT-FILE-NAME.
           DISPLAY (1 1) ERASE.
           DISPLAY (2 10) '***  STKADD      MENU      VERSION 81.FEB  ***'.
           DISPLAY (3 10) '***                                        ***'.
           DISPLAY (4 10) 'YOUR FILE NAME IS  >>>>>> '.
           ACCEPT (4 38) STOCK-INPUT-NAME WITH PROMPT
                                           UPDATE AUTO-SKIP BEEP.
           MOVE SPACES TO STOCK-INPUT-RECORD.
           OPEN EXTEND MASTER-FILE-IN.
           DISPLAY (1 1) ERASE.
           PERFORM MAIN-DRIVER UNTIL USER-DONE.
           IF  NOT MASTER-FILE-NOT-OPEN
               CLOSE  MASTER-FILE-IN.
           STOP RUN.

       MAIN-DRIVER.
           SET STK-TBL-INDEX TO 1.
           PERFROM DISPLAY-TABLE-BYPASS.
           IF  END-RUN
               PERFORM DISPLAY-END-OR-CONTINUE
               IF  END-RUN NEXT SENTENCE
               ELSE
                   PERFORM DISPLAY-MENU
           ELSE
               PERFORM DISPLAY-RESTART
               MOVE SPACES TO STOCK-TABLE-SWITCH
               IF  NOT RESTART-YES
                   PERFORM STOCK-TABLE-MAIN-LINE
               ELSE
                   PERFORM GET-RESTART-SYMBOL
                   IF  STOCK-TABLE-RESTARTING
                       PERFORM STOCK-TABLE-MAIN-LINE.

       STOCK-TABLE-MAIN-LINE.
           MOVE '1' TO STOCK-TABLE-SWITCH.
           DISPLAY (6 1) ERASE.
           DISPLAY (10 15) 'TRADE DATE MMDDYY'.
           ACCEPT (10 3) TRADE-DATE WITH PROMPT
                                   AUTO-SKIP ZERO-FILL.
           PERFORM DISPLAY-MENU
               VARYING STK-TBL-INDEX FROM STK-TBL-INDEX BY 1
               UNTIL STK-TBL-INDEX GREATER 120
               OR STOCK-TABLE-SYMBOL (STK-TBL-INDEX) = HIGH-VALUES.
           MOVE ' ' TO STOCK-TABLE-SWITCH.

       DISPLAY-MENU.
           DISPLAY (1 1) ERASE.
           DISPLAY (2 1) 'TYPE IN REQUESTED INFORMATION       '
                         '.....     RECORDS ADDED = ' STOCK-CARDS-IN.
           DISPLAY (10 15) 'TRADE DATE MMDDYY'.
           IF  STOCK-TABLE-IN-USE
               DISPLAY (10 3) TRADE-DATE
               MOVE STOCK-SYMBOL (STK-TBL-INDEX) TO SECURITY-SYMBOL
               DISPLAY (11 3) SECURITY-SYMBOL
               DISPLAY (11 15) STOCK-DESCRIPTION (STK-TBL-INDEX)
```

```
        ELSE
            DISPLAY (11 15) 'SECURITY SYMBOL  MAX 8 CHARACTERS'.
        DISPLAY (12 18) 'VOLUME   IN 100S   LIMIT 9999999'.
        DISPLAY (13 18) 'HIGH      -FORMAT WHOLE NUMBER '
                        'SPACE, PERIOD (.), DASH (-) FOLLOWED BY'
        DISPLAY (14 35) 'DECIMAL OR FRACTION. '
                        'MAX VALUE 999999.99999'.
        DISPLAY (15 29) 'HIT RETURN KEY <CR> WHEN DONE '.
        DISPLAY (16 18) 'LOW       -FORMAT SAME AS ABOVE'.
        DISPLAY (17 18) 'CLOSE     -FORMAT SAME AS ABOVE'.
        IF  NOT STOCK-TABLE-IN-USE
            ACCEPT (10 3) TRADE-DATE WITH PROMPT BEEP
                                    AUTO-SKIP ZERO-FILL
            ACCEPT (11 3) SECURITY-SYMBOL WITH PROMPT SPACE-FILL.
        ACCEPT (12 3) STOCK-VOLUME     WITH PROMPT
                                       AUTO-SKIP ZERO-FILL.
        ACCEPT (13 3) STOCK-HIGH       WITH PROMPT SPACE-FILL.
        ACCEPT (13 3) STOCK-LOW        WITH PROMPT SPACE-FILL.
        ACCEPT (13 3) STOCK-CLOSE      WITH PROMPT SPACE-FILL.

        DISPLAY (20 5) 'TYPE IN'.
        DISPLAY (21 10) '0 OR E    TO RETYPE LAST TRANSACTION'.
        DISPLAY (22 19) 'HIT ANY OTHER KEY TO CONTINUE'.
        DISPLAY (23 5) 'ENTER REPLY? '.
        ACCEPT (23 19) MENU-TYPE WITH PROMPT BEEP AUTO-SKIP.
        IF  END-RUN
            DISPLAY (1 1) ERASE
            GO TO DISPLAY-MENU.
        DISPLAY (1 1) ERASE.
        MOVE STOCK-HIGH         TO EDIT-IN.
        PERFORM EDIT-PRICE-FIELDS.
        MOVE EDIT-OUT           TO HIGH.
        MOVE STOCK-LOW          TO EDIT-IN.
        PERFORM EDIT-PRICE-FIELDS.
        MOVE EDIT-OUT           TO LOW.
        MOVE STOCK-CLOSE        TO EDIT-IN.
        PERFORM EDIT-PRICE-FIELDS.
        MOVE EDIT-OUT           TO CLOSING.
        MOVE 'STK'              TO RECORD-ID.
        ADD 1                   TO STOCK-CARDS-IN.
        COMPUTE STOCK-VOLUME = STOCK-VOLUME * 100.
        WRITE MASTER-IN-RECORD FROM STOCK-INPUT-RECORD.

        IF  STOCK-TABLE-IN-USE
            DISPLAY (20 5) 'TYPE IN'
            DISPLAY (21 10) '0 OR E    TO END TABLE SELECTION'
            DISPLAY (22 19) 'HIT ANY OTHER KEY TO CONTINUE'
            DISPLAY (23 5) 'ENTER REPLY? '
            ACCEPT (23 19) MENU-TYPE WITH PROMPT
                                    BEEP AUTO-SKIP.
        DISPLAY (1 1) ERASE.
        IF  END-RUN
            SET STK-TBL-INDEX TO 121.

    DISPLAY-TABLE-BYPASS.
   **
   **  HERE WE WANT TO DETERMINE IF THE USER WANTS TO USE
   **  TABLED STOCK ENTRIES OR NOT.
   **
        DISPLAY (17 5) 'TYPE IN'.
        DISPLAY (18 10) '0 OR E    TO BYPASS STOCK SELECTION OR'.
                        ' TO END THIS PROGRAM'.
        DISPLAY (19 19) 'HIT ANY OTHER KEY TO CONTINUE'.
        DISPLAY (20 5) 'ENTER REPLY? '.
        ACCEPT (20 19) MENU-TYPE WITH PROMPT BEEP AUTO-SKIP.

    DISPLAY-RESTART.
   **
   **  RESTART ROUTINE, SEE IF WE WANT TO RESTART FROM TABLE
   **
        DISPLAY (1 1) ERASE.
        DISPLAY (7 5) 'TYPE IN'.
        DISPLAY (8 14) 'Y      TO RESTART FROM ANY TABLED ITEMS'.
        DISPLAY (9 20) 'HIT ANY OTHER KEY TO CONTINUE'
        DISPLAY (10 5) 'ENTER REPLY? '.
        ACCEPT (10 20) MENU-TYPE WITH PROMPT BEEP AUTO-SKIP.

    DISPLAY-END-OR-CONTINUE.
   **
   **  SEE IF WE ARE FINISHED WITH THIS PROGRAM OR NOT
   **
        DISPLAY (1 1) ERASE.
        DISPLAY (17 5) 'TYPE IN'.
        DISPLAY (18 10) '0 OR E    TO TERMINATE ADD FUNCTION'.
        DISPLAY (19 19) 'ANY OTHER KEY TO CONTINUE'.
        DISPLAY (20 5) 'ENTER REPLY? '.
        ACCEPT (20 19) MENU-TYPE WITH PROMPT BEEP AUTO-SKIP.

        IF  END-RUN
            MOVE 'E' TO STOCK-TABLE-SWITCH.

    EDIT-PRICE-FIELDS.
   **
   **  ALL STOCK PRICES TO BE EDITED MUST USE THIS EDIT PROGRAM
   **  THREE PARAMETERS ARE REQUIRED, THE INPUT IN PIC X FORMAT
   **  MAX 12, THE OUTPUT IN MAX FORMAT PIC 999999V99999, BUT
   **  THE CALLING PROGRAM MAY TRUNCATE UNUSED NUMBERS, THE ERROR
   **  CODE IS NOT USED BY THIS CALLING PROGRAM BUT IS REQUIRED.
   **

        CALL 'EDTPRICE' USING EDIT-IN EDIT-OUT ERROR-CODE.

    RESTART-SEARCH.
   **
   **  THIS ROUTINE IS USED ONLY IF USING THE TABLE AND WE WANT
   **  TO START KEYING FROM OTHER THAN THE FIRST TABLE ITEM.
   **  IF  THE SYMBOL REQUESTED IS NOT IN THE TABLE A SWITCH IS
   **  SET TO 3, IF WE FOUND THE REQUESTED ITEM THEN THE INDEX
   **  STAYS SET AT ITS CURRENT SETTING AND THE SWITCH IS SET TO 2.
   **
        SEARCH ONE-STOCK
            AT END MOVE '3' TO STOCK-TABLE-SWITCH
        WHEN STOCK-SYMBOL (STK-TBL-INDEX) EQUAL RESTART-SYMBOL
        MOVE '2' TO STOCK-TABLE-SWITCH.

    GET-RESTART-SYMBOL.
   **
   **  GET THE STOCK SYMBOL FROM THE KEYBOARD FOR RESTARTING.
   **
        DISPLAY (1 1) ERASE.
        DISPLAY (7 5) 'TYPE IN'
```

```
        DISPLAY (8 10) 'STOCK SYMBOL TO RESTART FROM '
                       'FOLLOWED BY RETURN KEY <CR>'.
        DISPLAY (10 5) 'ENTER REPLY? '.
        ACCEPT  (10 19) RESTART-SYMBOL WITH PROMPT BEEP.
        PERFORM RESTART-SEARCH
            UNTIL STOCK-TABLE-RESTARTING
            OR    STOCK-TABLE-NOT-FOUND.

        IF  STOCK-TABLE-NOT-FOUND
            DISPLAY (12 10) 'STOCK SYMBOL ' RESTART-SYMBOL
                    ' IS NOT FOUND *** TRY AGAIN ?'.
    ADD-MENU-COMPLETE.
```

**Sample run**

```
TYPE STKINPUT.DAT
STK122480ACD     00005637500000005537500000005600000000022500
STK122480AA      00005975000000005912500000005975000000028600
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RECORD   STOCK---HIGH-.-----LOW--.-----CLOSE.-----VOLUME
ID DATE  SYMBOL
```

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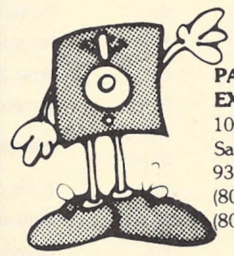

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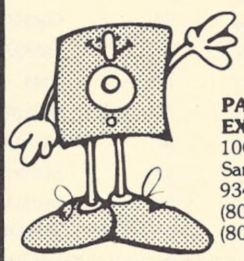

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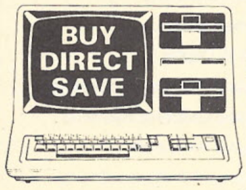


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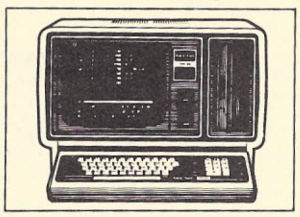

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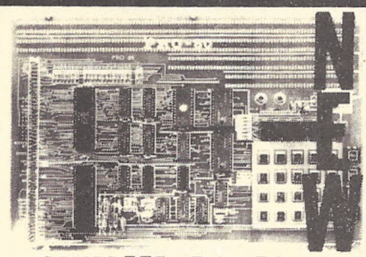


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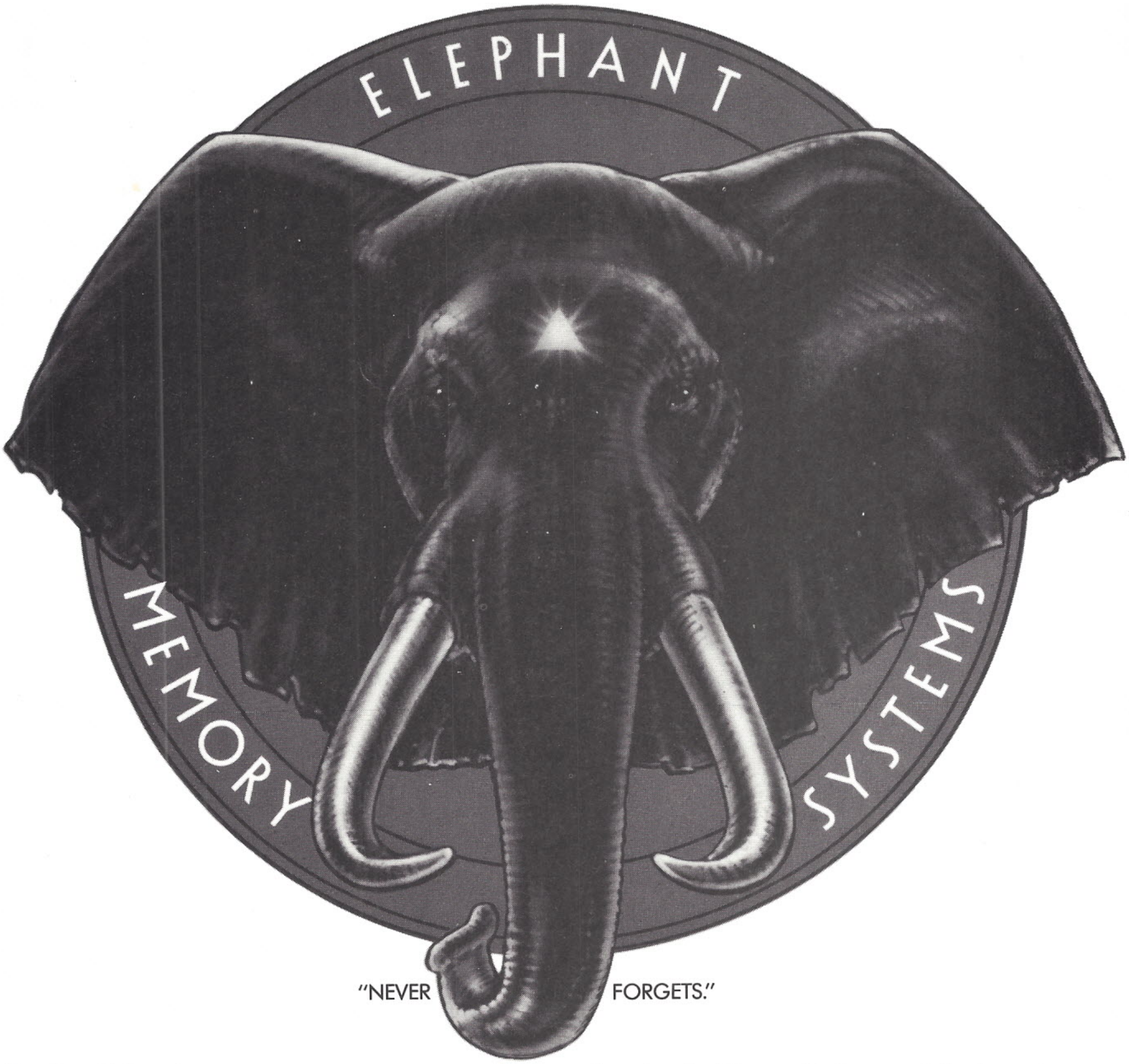


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